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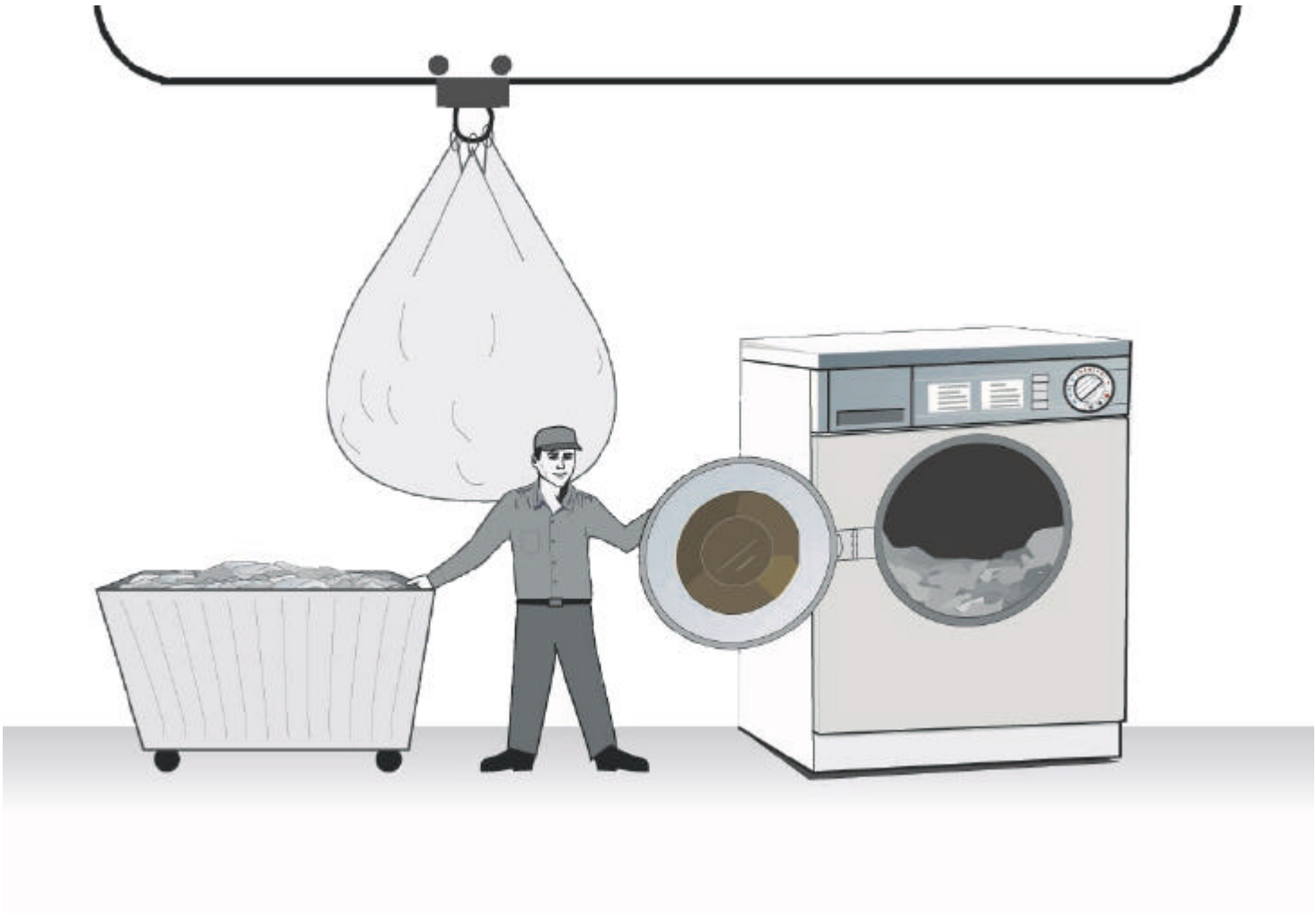

TECHNICAL DEVELOPMENT DOCUMENT FOR

THE FINAL ACTION REGARDING PRETREATMENT STANDARDS

FOR THE

INDUSTRIAL LAUNDRIES POINT SOURCE CATEGORY

(Revised March 2000)

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FOREWORD

This document includes technical support for the options considered during rulemaking for the Industrial Laundries Point Source Category.

After the Administrator signed the notice of final action, EPA received revised analytical data for some of the samples measured for semivolatile organic compounds, due to errors found in using dilution factors to calculate the sample concentrations. The revised data did not cause major changes, and provided a stronger basis for EPA's decision not to regulate this industry. Based on revised analytical data for semivolatile organic compounds for two sampling episodes conducted in 1996 and 1998, EPA revised this document in March 2000. The following chapters and appendices have been revised:

- Chapter 5
  —Table 5-11;
  —Table 5-12;
  —Table 5-14
  —Table 5-15; and
  —Table 5-16.

- Chapter 7
  —Table 7-1;
  —Table 7-3;
  —Table 7-4;
  —Table 7-5;
  —Table 7-7;
  —Table 7-11; and
  —Tables 7-12 through 7-16.

- Chapter 9
  —Table 9-1;
  —Table 9-4;
  —Tables 9-9 through 9-16.

- Appendix C
  —Table C-3; and
  —Table C-4.

- Appendix D, References D-4 through D-8.

- Appendix E.

Throughout the document, EPA refers to many commonly used titles and phrases by their acronyms to avoid spelling them out each time. As an aid to the reader, EPA has included in Chapter 12 a glossary of commonly used acronyms and definitions of terms used throughout the document.

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CHAPTER 1

SUMMARY

1.1 Introduction

This chapter presents a summary of the U.S. Environmental Protection Agency's (EPA's) decisions regarding effluent limitations guidelines and standards for the Industrial Laundries Point Source Category. Section 1.2 presents the scope and definition of the industry; Section 1.3 presents a brief overview of the industry; and Section 1.4 discusses EPA's final action.

1.2 Scope and Definition of the Industrial Laundries Industry

EPA has developed the following definition of industrial laundries:

> An *industrial laundry* is any facility that launders industrial textile items from off site as a business activity (i.e., launders industrial textile items for other business entities for a fee or through a cooperative arrangement). Either the industrial laundry facility or the off-site customer may own the industrial textile items. This definition includes textile rental companies that perform laundering operations. *Laundering* means washing with water, including water washing following dry cleaning. Laundering exclusively through dry cleaning and oil cleaning of mops in a process that does not use any water are not included in this definition of laundering. *Industrial textile items* include, but are not limited to: industrial shop towels, printer towels/rags, furniture towels, rags, uniforms, mops, mats, rugs, tool covers, fender covers, dust-control items, gloves, buffing pads, absorbents, and filters. If any of these items are used at hotels, hospitals, or restaurants, they are not considered industrial textile items.

A facility that performs any laundering of industrial textile items is classified as an industrial laundry, even if the facility also performs activities that are not defined as industrial laundering. EPA does not include the following activities within the scope of the industrial laundries industry: on-site laundering at industrial facilities (e.g., a chemical manufacturer that washes employee uniforms on site), laundering of industrial textile items originating from the same business entity (e.g., a chain of auto repair shops that operates a central laundry for items from individual shops), and exclusively laundering linen items, denim prewash items, clean room items, new items (i.e., items directly from the textile manufacturer, not yet used for their intended purpose), hotel, hospital, or restaurant items, or any combination of these items. However, EPA does consider hotels, hospitals, and restaurants to be within the scope of the industrial laundries industry if they launder industrial textile items originating from industrial facilities. Linen items include sheets, pillowcases, blankets, bath towels and washcloths, hospital gowns and robes,

tablecloths, napkins, tableskirts, kitchen textile items, continuous roll towels, laboratory coats, household laundry (such as clothes, but not industrial uniforms), executive wear, mattress pads, incontinence pads, and diapers (this list is meant to be all-inclusive).

1.3 Overview of the Industrial Laundries Industry

The industrial laundries industry includes facilities that launder industrial garments and uniforms, shop towels, printer towels/rags, mops, mats, and dust-control items. Either the laundry facilities or their customers own the laundered items. Many industrial laundries also wash other items not classified as industrial laundry items, such as linen garments, linen flatwork, health-care items, and miscellaneous other items.

Industrial laundries are located in all 50 states and all 10 EPA Regions. By state, the largest number of laundries are located in California. By EPA Region, the largest concentration of laundries is in Region V. Most of the laundering facilities are situated in large urban areas. EPA estimates that there are 1,742 industrial laundry facilities nationwide.

Industrial laundries vary in size from one- to two-person shops to large corporations that operate many facilities nationwide. The industry shows a correspondingly wide range of annual laundry production. Facilities laundering more than 15,000,000 pounds per year account for approximately eight percent of the total industry, whereas facilities laundering less than 3,000,000 pounds per year account for approximately 37 percent of the total industry. Approximately 10 percent of the facilities that meet EPA's definition of an industrial laundry launder less than 1,000,000 pounds per year.

Facilities wash most items using a water-washing process. Water washing involves washing items in water with detergents and other chemicals. Some facilities wash items using a dry-cleaning process, which involves washing items in an organic solvent. In some cases, facilities combine the two processes to wash items that have large amounts of both water-soluble and organic solvent-soluble soils. Dry cleaning followed by water washing of industrial textile items is considered an industrial laundry process. When water washing and dry cleaning are performed in series without drying the items between the water and solvent phases, the process is called dual-phase washing. The order in which these processes are performed depends on the solvent used, type of soil, and drying energy requirements. Some mops are laundered through a combination of water washing and oil treatment. The oil is applied to the mop to help collect dust during use. Both dual-phase washing of industrial textile items and water-washing/oil treatment of mops are considered industrial laundry processes.

Nationwide, industrial laundry facilities water-wash nearly 97 percent of their items. Approximately one percent of items are dry-cleaned, including items that are dry-cleaned and then water-washed. Dual-phase washing and mop cleaning with water and oil each accounts for less than one percent of the total production. The remaining laundry items are processed using other cleaning operations (e.g., oil cleaning of mops in a process that does not use any water). Chemicals frequently used in laundering operations include alkaline solutions, detergents, bleach, antichlor, sours, softeners, and starch. Other items that are added to some

wash formulas include enzymes, builders, oil treatment chemicals, water conditioners, dyes, stain treatment chemicals, and bactericides.

Based on data collected by EPA for the 1993 operating year, industrial laundries use over 90 percent of all incoming service water as laundry process water, followed in descending amounts by sanitary water, noncontact cooling water, and boiler water. All of the industrial laundries identified by EPA discharge their process wastewater to publicly owned treatment works (POTWs). The primary pollutants discharged by industrial laundries to POTWs include oil and grease, five-day biochemical oxygen demand (BOD_5), and total suspended solids (TSS), which are conventional pollutants, and a number of priority and nonconventional pollutants, including copper, lead, zinc, ethylbenzene, toluene, and total petroleum hydrocarbons (TPH), measured as silica gel treated-hexane extractable material (SGT-HEM)[1].

1.4 Final Action for the Industrial Laundries Point Source Category

EPA carefully considered all of the information in the Industrial Laundries Administrative Record, and has decided not to promulgate national categorical pretreatment standards for the Industrial Laundries Point Source Category because industrial laundry discharges to POTWs do not present a national problem warranting national regulation. EPA has determined that indirect discharges from industrial laundries do not warrant national regulation because of the small amount of pollutants removed by the pretreatment options determined to be economically achievable and because EPA believes that POTWs are generally not experiencing problems from industrial laundry discharges, and to the extent that isolated problem discharges occur, they will be controlled by the existing pretreatment program. EPA is not issuing effluent limitations guidelines or new source performance standards for direct dischargers because there are no direct discharging facilities in the industry and, therefore, EPA has no means to evaluate performance and develop guidelines.

Although EPA has decided not to promulgate national pretreatment standards, EPA evaluated technology performance data that can be used by control authorities to develop local limits on a best professional judgement (BPJ) basis. These data can be found in Chapter 7 of this document.

[1]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as TPH.

2.0 BACKGROUND

2.1 Introduction

This chapter presents background information supporting the development of effluent limitations guidelines and pretreatment standards for the Industrial Laundries Point Source Category. Section 2.2 presents the legal authority to regulate the industrial laundries industry. Section 2.3 discusses the Clean Water Act, the Pollution Prevention Act, and the Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act, as well as prior regulation of the industrial laundries industry.

2.2 Legal Authority

This final action for the Industrial Laundries Point Source Category is being performed under authority of sections 301, 304, 306, 307, 308, and 501 of the Clean Water Act (the Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C. 1251 et seq., as amended), also referred to as "the CWA" or "the Act."

2.3 Background

2.3.1 Clean Water Act (CWA)

The Clean Water Act (CWA) established a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (section 101(a)). To implement the Act, EPA is to issue effluent limitations guidelines, pretreatment standards, and new source performance standards for industrial dischargers.

These guidelines and standards are summarized briefly below:

1. Best Practicable Control Technology Currently Available (BPT) (section 304(b)(1) of the Act).

   BPT effluent limitations guidelines are generally based on the average of the best existing performance by plants of various sizes, ages, and unit processes within the category or subcategory for control of pollutants.

   In establishing BPT effluent limitations guidelines, EPA considers the total cost of achieving effluent reductions in relation to the effluent reduction benefits, the age of equipment and facilities involved, the processes employed, process changes required, engineering aspects of the control technologies, non-water quality environmental impacts (including energy requirements) and other factors as the EPA Administrator deems appropriate (section 304(b)(1)(B) of the Act). The Agency considers the category- or subcategory-wide cost of applying the technology in relation to the effluent reduction benefits. Where existing performance is

uniformly inadequate, BPT may be transferred from a different subcategory or category.

2. Best Available Technology Economically Achievable (BAT) (sections 304(b)(2)(B) and 307(a)(2) of the Act).

   In general, BAT effluent limitations represent the best existing economically achievable performance of plants in the industrial subcategory or category. The Act establishes BAT as the principal national means of controlling the direct discharge of priority pollutants and nonconventional pollutants to navigable waters. The factors considered in assessing BAT include the age of equipment and facilities involved, the process employed, potential process changes, and non-water quality environmental impacts, including energy requirements (section 304(b)(2)(B)). The Agency retains considerable discretion in assigning the weight to be accorded these factors. As with BPT, where existing performance is uniformly inadequate, BAT may be transferred from a different subcategory or category. BAT may include process changes or internal controls, even when these technologies are not common industry practice.

3. Best Conventional Pollutant Control Technology (BCT) (section 301(b)(2)(e) of the Act).

   The 1977 Amendments added section 301(b)(2)(E) to the Act establishing BCT for discharges of conventional pollutants from existing industrial point sources. Section 304(a)(4) designated the following as conventional pollutants: biochemical oxygen demanding pollutants (BOD), total suspended solids (TSS), fecal coliform, pH, and any additional pollutants defined by the Administrator as conventional. The Administrator designated oil and grease as an additional conventional pollutant on July 30, 1979 (44 FR 44501).

   BCT is not an additional limitation, but replaces BAT for the control of conventional pollutants. In addition to other factors specified in section 304(b)(4)(B), the Act requires that BCT limitations be established in light of a two-part "cost-reasonableness" test. [American Paper Institute v. EPA, 660 F.2d 954 (4th Cir. 1981)]. EPA's current methodology for the general development of BCT limitations was issued in 1986 (51 FR 24974; July 9, 1986).

4. New Source Performance Standards (NSPS) (section 306 of the Act).

   NSPS are based on the best available demonstrated treatment technology. New plants have the opportunity to install the best and most efficient production processes and wastewater treatment technologies. As a result,

NSPS should represent the most stringent numerical values attainable through the application of the best available demonstrated control technology for all pollutants (i.e., conventional, nonconventional, and priority pollutants). In establishing NSPS, EPA is directed to take into consideration the cost of achieving the effluent reduction and any non-water quality environmental impacts and energy requirements.

5. Pretreatment Standards for Existing Sources (PSES) (section 307(b) of the Act).

   PSES are designed to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of publicly owned treatment works (POTWs). The Act requires pretreatment standards for pollutants that pass through POTWs or interfere with POTWs' treatment processes or sludge disposal methods. The legislative history of the 1977 Act indicates that pretreatment standards are to be technology-based and analogous to the BAT effluent limitations guidelines for removal of toxic pollutants. For the purpose of determining whether to promulgate national category-wide pretreatment standards, EPA generally determines that there is pass through of a pollutant if the nationwide average percent of a pollutant removed by well-operated POTWs achieving secondary treatment is less than the percent removed by the BAT model treatment system. EPA retains discretion not to issue such standards where the total amount of pollutants passing through is not significant.

   The General Pretreatment Regulations, which set forth the framework for the implementation of categorical pretreatment standards, are found at 40 CFR Part 403. Those regulations contain a definition of pass through that addresses localized rather than national instances of pass through and does not use the percent removal comparison test described above (52 FR 1586; January 14, 1987).

6. Pretreatment Standards for New Sources (PSNS) (section 307(b) of the Act).

   Like PSES, PSNS are designed to prevent the discharges of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTWs. PSNS are to be issued at the same time as NSPS. New indirect dischargers, like the new direct dischargers, have the opportunity to incorporate into their plants the best available demonstrated technologies. The Agency considers the same factors in promulgating PSNS as it considers in promulgating NSPS. EPA retains discretion not to issue such standards where the total amount of pollutants passing through is not significant.

2.3.2 Pollution Prevention Act (PPA)

In the Pollution Prevention Act of 1990 (42 U.S.C. 13101 et seq., Pub.L. 101-508, November 5, 1990), Congress declared pollution prevention to be the national policy of the United States. The Act declares that pollution should be prevented or reduced whenever feasible; where the generation of waste materials cannot be prevented, the waste materials should be recycled or reused in an environmentally safe manner wherever feasible; waste materials that cannot be recycled should be treated; and disposal or release into the environment should be chosen only as a last resort. The PPA directs the Agency to, among other things, "review regulations of the Agency prior and subsequent to their proposal to determine their effect on source reduction" (Sec. 6604; 42 U.S.C. 13103(b)(2)). EPA considered pollution prevention during the development of this final action. Chapter 6 of this document describes the results of this effort.

2.3.3 Regulatory Flexibility Act (RFA) as Amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA)

Under the Regulatory Flexibility Act (RFA), 5 U.S. C. 601 et seq., as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA), EPA generally is required to conduct a regulatory flexibility analysis describing the impact of the regulatory action on small entities as part of rulemaking. EPA conducted an initial regulatory flexibility analysis (IRFA) for the proposal (62 FR 66181; December 17, 1997) for the industrial laundries industry. However, under section 605(b) of the RFA, if EPA certifies that a rule will not have a significant economic impact on a substantial number of small entities, EPA is not required to prepare a regulatory flexibility analysis. Because the Administrator has decided not to promulgate pretreatment standards for this industry, EPA did not prepare a final regulatory flexibility analysis because the requirement in section 604 of the RFA to prepare a regulatory flexibility analysis when an agency promulgates a final rule does not apply to this action.

However, as part of EPA's decision not to promulgate pretreatment standards for this industry, EPA conducted an analysis equivalent to a regulatory flexibility analysis addressing:

- The need for, objectives of, and legal basis for a rule.
- A description of, and where feasible, an estimate of the number of small entities to which a rule would apply.
- The projected reporting, recordkeeping, and other compliance requirements of a rule, including an estimate of the classes of small entities that would be subject to a rule and the types of professional skills necessary for preparation of the report or record.
- An identification, where practicable, of all relevant federal rules which may duplicate, overlap, or conflict with a rule.

- A description of any significant regulatory alternatives to a rule which accomplish the stated objectives of applicable statutes and which minimize any significant economic impact of a rule on small entities. Consistent with the stated objectives of the CWA, the analysis discussed significant alternatives such as:

  – Establishing differing compliance or reporting requirements or timetables that take into account the resources available to small entities.

  – Clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities.

  – The use of performance rather than design standards.

  – An exclusion from coverage of a rule, or any part thereof, for such small entities. Based on the regulatory flexibility analysis and other factors, EPA considered an exclusion to eliminate disproportionate impacts on small businesses which reduced the number of small businesses that would be affected by a rule.

Pursuant to the RFA as amended by SBREFA, EPA convened a Small Business Advocacy Review Panel. The Panel comprised representatives from three federal agencies: EPA, the Small Business Administration, and the Office of Management and Budget. The Panel reviewed materials EPA prepared in connection with the IRFA, and collected the advice and recommendations of small entity representatives. Small entity representatives included owners of small industrial laundries and trade association representatives. The Panel prepared a report (available in the Industrial Laundries Administrative Record) that summarizes their outreach to small entities and the comments submitted by the small entity representatives. The Panel's report also presented their findings on issues related to the elements of the IRFA.

2.3.4 Prior Regulation of the Industrial Laundries Point Source Category

The Federal Water Pollution Control Act Amendments of 1972 established a program to clean up the nation's waters that consisted of, along with other requirements, a program of establishing technology-based effluent limitations guidelines for point source dischargers by industry categories and a timetable for issuing these guidelines. Pursuant to a 1976 settlement agreement and the 1977 Clean Water Act Amendments, EPA was required to develop a program and adhere to a schedule in promulgating effluent limitations guidelines and pretreatment standards for 65 "toxic" pollutants and classes of pollutants, for 21 major industries. Moreover, the Agency is required by section 301 (d) of the Federal Water Pollution Control Act Amendments of 1972 and the Clean Water Act of 1977 to review and revise, if necessary, effluent limitations promulgated pursuant to sections 301, 304, 306, 307, 308, and 501 of the Act.

The Auto and Other Laundries Category, of which industrial laundries was a subcategory, was one of the categories mandated for study and possible effluent limitations guidelines and standards development by the 1976 Settlement Agreement. Several studies were undertaken in 1977 through 1980 to collect more information about the industrial laundries industry, including two surveys (1977 and 1979) and wastewater sampling and analysis programs conducted in 1978. However, in 1981, the Auto and Other Laundries Category, including the industrial laundries subcategory, was excluded from regulation. The industrial laundries subcategory was excluded because, based on assessments made at that time, it was determined that 95 percent of the industry discharged pollutants that could be treated by POTWs and that did not pass through, interfere with, or otherwise prove incompatible with the operation of POTWs.

However, following these assessments, additional data were collected by the Industrial Technology Division (ITD - now Engineering and Analysis Division (EAD)) as part of work efforts in conjunction with EPA's Office of Solid Waste's Resource Conservation and Recovery Act (RCRA) Program in 1985 through 1987. In 1986, EPA published its Domestic Sewage Study (DSS), which identified industrial laundries as potential contributors of large amounts of hazardous pollutants to the POTWs. Based on information gathered to that point, EPA compiled a profile of the industrial laundries industry that was published as a Preliminary Data Summary in 1989.

Section 304(m) of the Clean Water Act (33 U.S.C. 1314(m)), added by the Water Quality Act of 1987, requires EPA to establish schedules for (i) reviewing and revising existing effluent limitations guidelines and standards ("effluent guidelines"), and (ii) promulgating new effluent guidelines. On January 2, 1990, EPA published an Effluent Guidelines Plan (55 FR 80), in which schedules were established for developing new and revised effluent guidelines for several industrial categories. In addition, the plan listed several industrial categories that were to be studied to determine whether rulemakings to develop effluent guidelines and standards should be initiated. One of those categories was the Industrial Laundries Point Source Category, based on the results of the 1985 to 1987 work contained in the DSS.

Natural Resources Defense Council, Inc. (NRDC) and Public Citizen, Inc. challenged the Effluent Guidelines Plan in a suit filed in U.S. District Court for the District of Columbia (NRDC et al. v. Reilly, Civ. No. 89-2980). The plaintiffs charged that EPA's plan did not meet the requirements of section 304(m). A Consent Decree (the "304(m) Decree") in this litigation was entered by the Court on January 31, 1992 (57 FR 19748), which established schedules for, among other things, EPA's proposal and promulgation of effluent guidelines for a number of categories, including the Industrial Laundries Point Source Category. The Effluent Guidelines Plan update published on February 26, 1997 (62 FR 8726) required, among other things, that EPA propose effluent limitations guidelines and pretreatment standards for the Industrial Laundries Point Source Category by September 1997 and take final action by June 1999. Further modification of the Decree in August 1997 set the proposal date no later than November 7, 1997.

On December 17, 1997 (62 FR 66181), EPA published proposed pretreatment standards for the control of wastewater pollutants from the industrial laundries industry. EPA published a notice of data availability (NODA) on December 23, 1998 (63 FR 71054). The

NODA presented a summary of the data gathered or received from commenters since the proposal, an assessment of the usefulness of the data in EPA's analyses, and a discussion of a voluntary industry program submitted by the industry as part of comments on the proposal.

CHAPTER 3

DATA COLLECTION METHODOLOGY AND INFORMATION SOURCES

3.1 Introduction

In 1992, EPA published a notice in the Federal Register (57 FR 19748) indicating its intent to develop effluent limitations guidelines and standards for the Industrial Laundries Point Source Category. EPA collected information necessary for the development of these effluent guidelines and standards from many sources. EPA initially collected data on a broad group of laundry facilities that included industrial laundries as well as linen laundries, denim prewash facilities, and other laundry facilities. These data were necessary to define the scope of the industry. Throughout this chapter, the term "laundry" is used to indicate that information was collected from industrial laundries as well as other laundry facilities, such as facilities that launder only linen items.

On December 17, 1997 (62 FR 66181), EPA published proposed pretreatment standards for the Industrial Laundries Point Source Category, based on EPA's data collection efforts. In response to this proposal, EPA obtained data from industry and publicly owned treatment works (POTWs), which were described in the Notice of Data Availability (NODA) published on December 23, 1998 (63 FR 71054). EPA received additional data from industry and POTWs in comments on the NODA.

This chapter summarizes the information collection activities undertaken and the information sources used to develop the final action for the Industrial Laundries Point Source Category, as presented below:

- Section 3.2 summarizes data collection efforts prior to 1992;
- Section 3.3 discusses the questionnaire activities conducted after 1992;
- Section 3.4 summarizes EPA's site visit program conducted from 1993 through 1998;
- Section 3.5 discusses EPA's sampling program conducted from 1993 through 1998;
- Section 3.6 discusses EPA's Method 1664 Characterization Study;
- Section 3.7 presents other industry-supplied data;
- Section 3.8 discusses data collected from POTWs;
- Section 3.9 summarizes literature searches performed on the industrial laundries industry;

- Section 3.10 summarizes other sources of data on the industrial laundries industry; and

- Section 3.11 presents the references used in this chapter.

3.2 Summary of Data Collection Prior to 1992

Prior to 1992, EPA conducted several studies of the laundries industry. These efforts consisted of the following:

- The 1971 EPA survey of 160 industrial laundries, linen services, and diaper services (Section 3.2.1);

- The 1975 data collection at 73 facilities (Section 3.2.2);

- The 1977 data collection portfolio (DCP) for approximately 70 facilities (Section 3.2.3);

- The 1978 screening and verification analysis of samples from approximately 10 facilities for priority pollutants (Section 3.2.4);

- The 1979 laundries survey (Section 3.2.5); and

- The 1985 through 1987 Industrial Technology Division (ITD)/Resource Conservation and Recovery Act (RCRA) sampling program and development of the Preliminary Data Summary for the Industrial Laundries Industry (1) (Section 3.2.6).

Sections 3.2.1 through 3.2.6 describe each of these data-gathering efforts in more detail.

3.2.1 1971 Survey

EPA's first study of the industrial laundries industry, initiated in 1971, involved sending a survey to 160 facilities. These facilities were all members of the Institute of Industrial Launderers (IIL, now the Uniform and Textile Service Association (UTSA)) or the Linen Supply Association of America (LSAA, now the Textile Rental Services Association of America (TRSA)) and included industrial laundries, linen services, and diaper services. In addition to wastewater analytical data obtained from the survey, EPA analyzed wastewater samples it had collected at a small number of facilities for conventional and nonconventional pollutants and some metals.

3.2.2 1975 Data Collection

In 1975, EPA initiated sampling and analysis of wastewaters generated by the Auto and Other Laundries Point Source Category, of which the industrial laundries industry was

identified as a subcategory. These early programs concentrated primarily on collecting data on conventional and nonconventional pollutants and trace metals. EPA collected samples at 73 laundries for conventional pollutants (pH, biochemical oxygen demand (BOD_5), total suspended solids (TSS), and oil and grease) and nonconventional pollutants (chemical oxygen demand (COD), total organic carbon (TOC), and phosphorus).

3.2.3 1977 Data Collection Portfolio (DCP)

In 1977, EPA sent a data collection portfolio (DCP) to a number of laundry facilities including industrial laundries (SIC Code 7218), power laundries (SIC Code 7211), linen supply laundries (SIC Code 7213), and institutional laundries. Completed DCPs were received from approximately 70 industrial laundries. The survey requested the following types of information:

- Type of laundry;
- Number of hours/day and days/year of operation and number of employees;
- Types of processes;
- Production information;
- Types of customers serviced;
- Laundering chemicals used;
- Water usage;
- Effluent discharge;
- Information on wastewater treatment and in-plant controls;
- Recommendations for design features;
- Space available for treatment;
- Available priority pollutant data; and
- Unique features.

3.2.4 1978 Sampling Program

In 1978, EPA initiated a sampling program to determine the presence and concentrations of 129 priority pollutants, which were identified from the 65 toxic pollutants and classes of pollutants (and subsequently reduced to 126 priority pollutants), as defined by the

1976 Consent Decree (see Section 2.3.4 of this document for discussion of the Consent Decree), in wastewaters from facilities in the Auto and Other Laundries Point Source Category. EPA sampled a total of 40 facilities for toxic and conventional pollutants using automatic time-compositing equipment during operating hours at each facility. In most cases, sampling was for one day only. At facilities where wastewater treatment was in place, EPA collected samples of both treatment system influent and effluent. Over a one-month period, EPA also sampled an industrial laundry that used a dissolved air flotation (DAF) treatment system to obtain data on the variability of treatment efficiency for this type of technology.

3.2.5 1979 Laundries Survey

In 1979, EPA sent a survey to 31 industrial laundries and 14 linen laundries in five major cities to determine the availability of sufficient space for installation of treatment systems. Approximately 50 percent of the survey dealt specifically with available space at facilities without treatment. Other information obtained included:

- Business classification;
- Number of hours/day and days/year of operation and number of employees;
- Processes used;
- Production information;
- Water usage;
- Effluent discharge;
- In-plant controls used; and
- Wastewater treatment practiced.

EPA conducted the Industrial Technology Division (ITD)/Resource Conservation and Recovery Act (RCRA) Sampling Program and the Preliminary Data Study in response to a recommendation made in the Domestic Sewage Study and because of concern for the potential discharge of toxic pollutants. In 1981, EPA decided not to establish effluent limitations guidelines and standards for the Auto and Other Laundries Point Source Category, of which industrial laundries were a subcategory, because EPA determined that 95 percent of the discharged pollutants were amenable to treatment by POTWs and did not pass through, interfere with, or prove otherwise incompatible with the operation of POTWs. Therefore, no further data collection efforts were undertaken until 1985.

3.2.6 Industrial Technology Division (ITD)/Resource Conservation and Recovery Act (RCRA) Sampling Program and Development of the Preliminary Data Summary (1985 through 1987)

EPA conducted a program to obtain wastewater and solid waste samples at five industrial laundries located in different regions of the U.S. EPA used information obtained during previous data-gathering efforts in conjunction with advice and assistance from the UTSA (known as the Institute of Industrial Launderers (IIL) at the time) to select seven laundries for site visits. Four of these facilities were sampled in 1986 and 1987. The fifth facility was sampled in 1985 as part of the Domestic Sewage Study (discussed in Section 3.10.3 of this document).

At the industrial laundry sampled in 1985, EPA collected composite samples of the final effluent from a settling basin over the course of one operating day. EPA collected samples of untreated wastewater streams and final effluent at the four other industrial laundry facilities. EPA sampled these four facilities for two consecutive days and composited the wastewater over the course of each operating day. EPA collected final effluent samples from two DAF systems, one ultrafiltration system, and a settling basin.

EPA analyzed the samples for conventional pollutants, priority and nonconventional organic pollutants, metal pollutants, and other nonconventional pollutants.

Other EPA activities to collect information about the industrial laundries industry investigated during this time period included:

- Telephone interviews with, and visits to, personnel at EPA regional and state offices, industry trade associations, and representative industrial laundries;
- Telephone interviews with POTW representatives; and
- Literature review, including research reports, journals and magazines, computer-based abstract databases, and computer-based censuses.

The information collected during 1985 to 1987 was used to prepare the Preliminary Data Summary for the Industrial Laundries Industry (1) and formed the basis for EPA's decision to initiate work on effluent limitations guidelines and standards for the Industrial Laundries Point Source Category in 1992.

3.3 Summary of Industrial Laundries Questionnaire Activity After 1992

EPA's first step in developing a rule for the industrial laundries industry was to gather current data from the industry, under the authority of section 308 of the Clean Water Act. EPA conducted a screener survey by sending questionnaires to four different segments of the laundry industry between 1993 and 1995. The screener questionnaires requested information to be used in identifying the population of the laundry industry, developing the scope of the

regulation, and determining which facilities should receive a more detailed questionnaire. Based on data collected from the screener survey and a search of the Dun & Bradstreet listing for laundry facilities, EPA identified a representative subset of laundries to receive a detailed questionnaire. Based on the responses to this detailed questionnaire, EPA sent an additional questionnaire to a subset of the facilities that had received the detailed questionnaire to obtain effluent monitoring data. These data-gathering efforts are described in more detail below. Additional details on the data-gathering efforts are also contained in the Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category (2). Copies of completed nonconfidential questionnaire responses are contained in the Industrial Laundries Administrative Record.

3.3.1 Screener Questionnaires

EPA conducted four separate mailings of slightly different screener questionnaires to collect data it could use to define the scope of the industrial laundries industry, identify the population of the industry, and select facilities to receive the more detailed questionnaire. EPA also used the screener questionnaires to characterize the industry and to determine the size of the industrial laundries population. More details on determining the industrial laundries population are provided in the Statistical Support Document (2). Summarized industry characterization data are provided in Chapters 4, 5, and 6 of this document. The four different screener questionnaires and their mailings are discussed in the following sections.

3.3.1.1 The 1993 Industrial Laundries Industry Screener Questionnaire

In 1993, EPA developed and mailed out the two-page 1993 Industrial Laundries Industry Screener Questionnaire to 1,751 industrial laundries to solicit updated information on the industry. The screener questionnaire requested information on the relative amounts and types of items received for laundering, the type of waste treatment operations, the amount of water used, and wastewater disposal practices. A blank copy of the questionnaire, along with copies of the nonconfidential portions of the completed screener questionnaires, are contained in Section 6.2 of the Industrial Laundries Administrative Record.

EPA sent the screener questionnaire to a total of 1,751 facilities. EPA selected 1,745 of these facilities from the UTSA customer and prospective customer lists, the Textile Rental Service Association (TRSA) mailing list, and the Occupational Safety and Health Administration's (OSHA) list of violations for industrial laundries. EPA added six facilities to the list as a result of companies requesting screeners for their facilities that had not received one.

Of the 1,751 screener questionnaires mailed, 1,543 were returned. In addition, three facilities that were not on the mailing list received a copy of the screener from their parent company, and returned the completed copy, bringing the total of completed screener questionnaires returned to 1,546. A summary of the results of the screener questionnaire mailings is shown in the following table.

Status of 1993 Screener Questionnaire	Number of Questionnaires
Returned	1,546[1]
Screener undeliverable or facility known to be out of scope	86
Nonresponsive	122
Duplicate facilities found	46[2]
Total	1,754

[1]Three facilities not on the original mailing list completed and returned the questionnaire at the request of their parent company.
[2]This number is included in the number of screeners returned.

EPA received the screener questionnaire responses, reviewed them for completeness and accuracy, and entered the information into a database. EPA contacted by telephone respondents who provided incomplete or contradictory technical information to obtain correct information.

3.3.1.2 1993 Industrial Laundries Industry Supplemental Screener Questionnaire

The Dun & Bradstreet listing was used to identify industrial laundries not captured by the trade association mailing lists developed for the original screener questionnaire. Facilities listed in Dun & Bradstreet with primary SIC codes of 7218 (industrial laundries) or 7213 (linen supply laundries) and facilities with secondary SIC codes of 7218 were identified and compared to the original screener questionnaire mailing list. EPA selected 200 facilities identified from the Dun & Bradstreet listing to receive the supplemental screener questionnaire to obtain more data representative of the entire industry as follows: 100 facilities with a primary SIC code of 7218; 60 facilities with a primary SIC code of 7213; and 40 facilities with a secondary SIC code of 7218. The table below summarizes the results of the supplemental screener questionnaire mailing.

Status of D&B Screener Questionnaires	Number of Questionnaires
Returned	134
Screener undeliverable	34
Nonresponsive	32
Total	200

EPA received the screener questionnaire responses, reviewed them for completeness and accuracy, and entered the information into a database. EPA contacted by telephone respondents who provided incomplete or contradictory technical information to obtain correct information.

3.3.1.3 Large Industrial Laundry Screener

Abbreviated screener questionnaires were sent to five large industrial laundry companies to identify facilities owned by these five companies that were not identified from the original screener questionnaire or the supplemental screener questionnaire. Abbreviated screener questionnaires were also sent to four additional facilities that were not included on the mailing list for the original screener due to lack of address information. Information from the abbreviated screener, along with information from the other screener questionnaire, was used to determine the industrial laundry industry population.

3.3.1.4 1995 Industrial Laundries Industry Screener (On-Site) Questionnaire

In response to comments from industrial laundry and linen trade associations, EPA mailed 100 modified screener questionnaires in January 1995 to hospitals, hotels, and prisons that potentially operate on-site laundries. These facilities are not traditional industrial laundry facilities, but generate wastewater from laundering. EPA randomly selected 25 facility addresses from each of the following four sources:

- A list provided by the TRSA;
- A list provided by the UTSA;
- Responses to Question 25 (Q25) in Part B of the 1994 Industrial Laundries Industry Questionnaire; and
- National Association of Institutional Linen Management (NAILM) members.

The 1995 screener questionnaire requested the following information: discharge status (i.e., direct, indirect, zero), water use information, amount of laundry accepted from off site, the amount of total laundry processed, number of employees, SIC code, percentage of items laundered (both generated on site and accepted from off site), and type of treatment system. The main goal of this effort was to obtain a snapshot of the activities of on-site laundries to determine if they should be included in the scope of the industrial laundries industry. EPA received 86 responses to the 1995 screener questionnaire.

3.3.2 1994 Industrial Laundries Industry Questionnaire (Detailed Questionnaire)

EPA designed the 1994 Industrial Laundries Industry Questionnaire (detailed questionnaire) to collect detailed technical and economic information from industrial laundry and linen facilities. EPA sent the detailed questionnaire to laundries statistically selected from the 1993 Industrial Laundries Industry Screener Questionnaire database (screener questionnaire database) and from the Dun & Bradstreet database. Additional information concerning the selection of facilities to receive the detailed questionnaire is presented in the Statistical Support Document (2). EPA used the information reported by the respondents in the detailed questionnaire to develop an industry profile, characterize industry production and water use,

develop pollutant loadings and reduction estimates, and develop compliance cost estimates, as discussed throughout this document. A blank copy of the detailed questionnaire and copies of the nonconfidential portions of the completed detailed questionnaires are contained in the Industrial Laundries Administrative Record.

3.3.2.1 Detailed Questionnaire Recipient Selection and Mailing

EPA mailed the detailed questionnaire in June and July of 1994 to 250 selected laundries. EPA selected 24 facilities from the Dun & Bradstreet database and 226 facilities from the industrial laundries industry screener database. After mailing the questionnaires, EPA deactivated the questionnaires for one of the selected Dun & Bradstreet facilities and three of the selected screener questionnaire facilities because they were closed, out of scope, or otherwise unable to respond to the questionnaire. EPA replaced these facilities with other facilities not previously selected. The methods used to select the recipients of the detailed questionnaires are described in the Statistical Support Document (2). A summary of the results of the mailout of the 254 detailed questionnaires is shown in the following table.

Activity	Number of Sites
Mailed detailed questionnaire (four questionnaires were mailed to replace four facilities determined to be inactive within a few days of the initial mail-out)	254[1]
Questionnaires received	231
Questionnaires not received	23
Questionnaires deactivated (deactivated because facility closed, facility was a pretest facility, facility destroyed by fire, facility did not generate laundry wastewater, or otherwise could not provide the necessary information)	16 (Not received-12) (Received-4)
Questionnaires with sufficient technical and economic information to perform the analyses necessary to conduct a final action	208

[1]EPA originally selected 250 recipients of the detailed questionnaire and later selected another four to replace facilities that had been deactivated.

In addition, EPA mailed pretest questionnaires to nine facilities in November 1993. Although not identical, the pretest questionnaire contained questions similar to the questionnaire mailed in June and July of 1994. EPA received eight pretest questionnaire responses.

3.3.2.2 Information Collected by the Detailed Questionnaire

This section describes the information collected in each part of the detailed questionnaire and the reasons this information was collected. The Information Collection Request (ICR) (3) for this project contains further details on the types of information collected and the potential use of the information.

EPA developed the detailed questionnaire in conjunction with the industrial laundries trade associations (TRSA and UTSA), EPA's Office of Pollution Prevention and

Toxics, and EPA's Office of Solid Waste to collect information necessary to develop effluent limitations guidelines and standards for the industrial laundries industry. EPA sent a draft version of the questionnaire to nine pretest facilities, and incorporated comments from these facilities into the final version of the detailed questionnaire.

The detailed questionnaire comprised the following parts:

- Part A: Technical Information
  - -- Section 1: Facility Identification,
  - -- Section 2: Operating Information; and

- Part B: Financial and Economic Information
  - -- Section 1: Facility Financial Information,
  - -- Section 2: Owner Company Financial Information,
  - -- Section 3: Parent Company Financial Information.

Part A, Section 1 requested information necessary to identify the site and to determine wastewater discharge locations (to surface water or POTWs). The information requested in this section included site name, address, parent company name, address, site contact, age of facility, major modifications made to the facility, operating hours and days, permits held by the facility, and wastewater discharge location.

Part A, Section 2 was divided into the following subparts:

- Process Operations and Production Information;
- Water Use and Conservation Practices; and
- Wastewater Treatment Operations.

The section on process operations and production information requested detailed information on laundering processes, types of items laundered, production of laundered items, types of customers, laundering formulas, laundering chemicals, laundering equipment, and pollution reduction activities. EPA used the information collected in this section to determine the types and amounts of each item laundered at a facility, the types of customers a facility has, the amount of laundering chemicals and water used for laundering each item type, and pollution reduction practices at laundry facilities.

The section on water use and conservation practices requested detailed information on water intake amounts for various uses, water conservation practices in place, wastewater generation and discharge locations, and a facility process diagram showing a water balance for the facility and wastewater treatment in place. EPA used this information to evaluate the overall water use and wastewater discharge for the site.

The section on wastewater treatment operations requested detailed information on wastewater treatment operations, costs of wastewater treatment equipment, wastewater sample collection, wastewater treatment residual types and generation amounts, costs of residual

disposal, and space availability at the facility. EPA used this information to evaluate current treatment in place at industrial laundries and the costs of operating this treatment.

Part B requested detailed financial and economic information for each site and the owner companies of each site. Detailed information on this section is presented in the Economic Assessment for the Final Action Regarding Pretreatment Standards for the Industrial Laundries Point Source Category (4).

3.3.2.3 Data Review and Data Entry

EPA completed a detailed engineering review of Part A of the detailed questionnaires to evaluate the accuracy of information provided by the respondents. During engineering review, responses to questions were coded to facilitate data entry into the detailed questionnaire database. The Data Element Dictionary for the Industrial Laundries Industry Questionnaire Part A Database (5) contains the codes used by reviewers. EPA contacted, by telephone, respondents who provided incomplete or contradictory technical information to obtain correct information.

EPA developed a database for the technical information provided by the detailed questionnaire respondents. After engineering review and coding, data from the detailed questionnaires were double-key entered using a data entry and verification system. Reviewers of the questionnaire verified errors in the double-key entry. EPA entered basic information (i.e., name, address, telephone number, etc.) for all 254 facilities into the database. EPA entered other information provided by the 231 facilities responding to Part A. EPA also entered the information for three pretest facilities.

3.3.2.4 Compilation of Respondent Data

EPA compiled information reported in the detailed questionnaire and summaries of this information are located in Chapters 4, 5, and 6 of this document. These chapters include information on facility location, process and production information, water use and discharge practices, and wastewater characteristics and treatment.

3.3.3 Detailed Monitoring Questionnaire

In 1995, EPA mailed a detailed monitoring questionnaire (DMQ) to 37 industrial laundries that had received the detailed questionnaire in 1994. After reviewing responses to the detailed questionnaire, EPA identified facilities with available monitoring data that could be used to identify effluent discharge quality after certain treatment technologies and in conjunction with laundering certain industrial items. EPA selected the industrial laundries that would receive the DMQ based on the following criteria:

- Facilities that EPA had sampled;
- Facilities with paired monitoring data (i.e., facilities that monitor both influent and effluent pollutant concentrations);

- At least one facility with each technology being considered for inclusion in the treatment technology options; and
- Facilities that had no treatment (or that have gravity settling and screens only) to characterize untreated industrial laundry wastewater and current pollutant discharge loadings.

The DMQ requested that facilities submit analytical data they had reported (but not submitted) in their detailed questionnaire responses and any additional data that were available (e.g., raw wastewater data, POTW data, chemical vendor data, wastewater treatment vendor data, disposal company data). The facilities were also asked to include a process diagram for verification of sampling points. All 37 recipients completed and returned their DMQ.

3.3.3.1 Data Review and Data Entry

EPA completed a detailed engineering review of the DMQs to evaluate the accuracy of information provided by the respondents. The engineering review also included coding of responses to questions to facilitate data entry into the DMQ database. The Data Element Dictionary for the DMQ Database (6) contains the codes used by reviewers. EPA contacted, by telephone, respondents who provided incomplete or contradictory technical information to obtain correct information.

EPA developed a database for the technical information provided by the DMQ respondents. After engineering review and coding, data from the DMQ were double-key entered using a data entry and verification system. Reviewers of the questionnaires verified errors in the double-key entry. EPA entered information for all 37 facilities into the DMQ database.

3.3.3.2 Compilation of Respondent Data

EPA compiled information reported in the DMQ responses and summarized it in Chapter 5 of this document, which includes information on wastewater characteristics. DMQ data were also used to develop summaries reflecting wastewater control technology performance for the industrial laundries industry, as presented in Chapter 7 of this document.

3.4 Summary of EPA's Site Visit Program (1993-1998)

EPA conducted 38 site visits to industrial laundries between 1993 and 1998 to collect information about industrial laundry processes, water use practices, pollution reduction practices, wastewater treatment technologies, and waste disposal methods. EPA also visited these sites to evaluate potential sampling locations (as described in Section 3.5 of this document). EPA visited a range of laundry facilities, such as industrial laundries, linen facilities, hospital cooperative laundries, clean room facilities, and denim prewash facilities, to collect data it could use to define the scope of the industry.

3.4.1 Criteria for Site Visit Selection

EPA based site selection on information in responses to the screener and detailed questionnaires and information obtained from the industrial laundries trade associations. In addition to choosing sites of varying sizes, EPA used the following general criteria to select sites that encompassed the range of processes and treatment technologies within the industrial laundries industry:

- The site laundered a broad range of industrial textile items;
- The site performed specific operations, such as denim prewashing or dry cleaning followed by water washing;
- The site had wastewater treatment technologies that were believed to be representative of the "best" within the industry;
- The site split heavy and light wastewater streams; and
- The site practiced water reuse.

3.4.2 Types of Information Collected

EPA documented information for each site visit in a site visit report; these reports are contained in the Industrial Laundries Administrative Record. During the site visits, EPA collected the following information for each facility:

- Types of laundering processes conducted and the types of items laundered, as well as the production volume of each item;
- Types of customers served;
- Types and sizes of laundering equipment used;
- Types, amounts, and disposition of wastewater generated;
- Types of pollution reduction activities performed;
- Types of wastewater treatment technologies operated; and
- Logistical information for sampling.

3.5 Summary of EPA's Sampling Program (1993-1998)

EPA conducted sampling episodes at nine facilities between 1993 and 1998 to obtain data on the characteristics of industrial laundry wastewaters and to assess the following: the amount of pollutants discharged to POTWs from industrial laundries; the effectiveness of

technologies designed to reduce and remove pollutants from industrial laundry wastewater; and the variation of wastewater characteristics across item type.

3.5.1 Criteria for Sampling Site Selection

EPA used information collected during industrial laundry site visits to identify candidate sites for sampling. EPA used the following general criteria to select sites for sampling:

- The site accepted a variety of items for laundering; and
- The site operated in-process source reduction or end-of-pipe treatment technologies that were considered for treatment technology option development.

After selecting a site for sampling, EPA prepared a detailed sampling and analysis plan, based on the information obtained during the site visit and follow-up contact with the site. The sampling and analysis plans were prepared to ensure collection of samples that would be representative of the sampled waste streams, and contained the following types of information: site-specific selection criteria for sampling; information about site operations; sampling point locations and sample collection, preservation, and transportation procedures; site contacts; and sampling schedules.

3.5.2 Information Collected

In addition to wastewater samples, EPA collected the following types of information during each sampling episode:

- Dates and times of sample collection;
- Flow data corresponding to each sample;
- Production data corresponding to each wastewater sample;
- Design and operating parameters for source reduction and treatment technologies characterized during sampling;
- Information about site operations that had changed since the site visit or that was not included in the site visit report; and
- Temperature and pH of the sampled wastewater streams.

EPA documented all data collected during sampling episodes in the Sampling Episode Report (SER) for each sampled site; these reports are contained in the Industrial Laundries Administrative Record. The sampling episode reports also contain preliminary technical analyses of treatment system performance.

3.5.3 Sample Collection and Analysis

All samples were collected, preserved, and transported according to EPA protocols as specified in EPA's Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants (7). This document is contained in the Industrial Laundries Administrative Record.

In general, EPA collected composite samples from the wastewater streams from laundering operations over the course of the operating day. Most facilities were sampled for a consecutive five-day period. For item-specific sampling, EPA collected wastewater samples from individual laundered loads during each discharge from the washer and composited the samples. EPA collected the required types of quality control samples as described in the Industrial Laundries Quality Assurance Project Plan (QAPP), such as blanks and duplicate samples, to verify the precision and accuracy of sample analyses.

EPA had samples shipped via overnight air transportation to EPA-approved laboratories, which analyzed the samples for metal and organic pollutants and additional parameters (including several water quality parameters). The laboratories analyzed metal pollutants using EPA Method 1620 (8), volatile organic pollutants using EPA Method 1624 (9), and semivolatile organic pollutants using EPA Method 1625 (10). Tables A-1 and A-2 in Appendix A of this document list the metal and organic pollutants, respectively, analyzed using these methods. The laboratories analyzed oil and grease and total petroleum hydrocarbon (TPH) using EPA Method 1664 (11), which is now promulgated at 40 CFR, Part 136. Method 1664 measures oil and grease as n-hexane extractable material (HEM) and measures TPH as silica gel treated-hexane extractable material (SGT-HEM[1]). Method 1664 may extract a different fraction of oil and grease and TPH than is extracted by the freon methods. The amount extracted by n-hexane and freon is dependent upon the composition of oils and grease in the samples. Sludge samples were analyzed using both the regular wastewater methods and the Toxicity Characteristic Leaching Procedure (TCLP), using SW-846, Method 1311 (12). Table A-3 in Appendix A of this document lists other parameters analyzed during the sampling program and the methods by which they were analyzed (13, 14).

Quality control (QC) measures used in performing all analyses complied with the guidelines specified in the analytical methods and in the QAPP. EPA reviewed all analytical data to ensure that these measures were followed and that the resulting data were within the QAPP-specified acceptance criteria for accuracy and precision.

As discussed previously, upon receipt and review of the analytical data for each site, EPA wrote a sampling episode report (SER) to document the sampling episode, the data collected during sampling, the analytical results, and the technical analyses of the results. The SERs include sampling and analysis plans and correspondence with site personnel as appendices.

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[1]In Method 1664 (promulgated at 64 FR 26315; May 14, 1999), EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as TPH.

3.6 Summary of EPA's Method 1664 Characterization Study

In response to comments on the proposed rule, EPA conducted a characterization study of wastewater generated at industrial laundries to determine the specific constituents of oil and grease and TPH, measured using EPA Method 1664. EPA collected influent and effluent samples from six facilities that operate DAF or chemical precipitation, and were previously sampled by EPA.

Samples from the facilities were analyzed for volatile organics by Method 1624, semivolatile organics by Method 1625, and oil and grease and TPH by Method 1664. Two additional oil and grease/TPH aliquots were collected for the Method 1664 characterization study analysis. These aliquots were subjected to the Method 1664 oil and grease and TPH analytical protocols, and the oil and grease and TPH residues were subsequently dissolved in an appropriate solvent and analyzed for volatile organics by modified Method 1624 and semivolatile organics by modified Method 1625. These analyses allow for comparison between the organic constituents measured in the wastewater and the organic constituents of the fractions measured as oil and grease and TPH. The analytical protocols prepared by EPA's Sample Control Center (SCC) used in this characterization study are presented in The Study Plan for Determination of the Components of n-Hexane Extractable Material (HEM) and Silica Gel Treated n-Hexane Extractable Material (SGT-HEM; Non-polar Material) in Discharges from Selected Industrial Laundry Facilities (15).

All samples were collected, preserved, and transported according to EPA protocols as specified in EPA's Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants (7) and the Industrial Laundries QAPP. All samples were preserved on site and shipped via overnight air transportation to the EPA-approved laboratories.

Quality control (QC) measures used in performing all analyses complied with the guidelines specified in the analytical methods and in the QAPP. EPA reviewed all analytical data to ensure that these measures were followed and that the resulting data were within the QAPP-specified acceptance criteria for accuracy and precision.

The results and data collected during this study are presented in Chapter 5 of this document and Section 16.2 of the Industrial Laundries Administrative Record.

3.7 Other Industry-Supplied Data

The industrial laundry trade associations, the Uniform and Textile Service Association (UTSA), and the Textile Rental Services Association (TRSA), as well as individual laundries and other interested parties, submitted data to be used in the development of the proposed rule and in the final action.\

3.7.1 Data Submitted Prior to 1992

In 1977, TRSA sponsored a wastewater study of linen and industrial laundries. In addition to pH, this study analyzed wastewater for the following 10 pollutants: BOD_5, TSS, oil

and grease, lead, mercury, nickel, cadmium, zinc, total chromium, and TOC. The two-part study first analyzed untreated wastewater from 20 laundries and then analyzed untreated and treated wastewater from five laundries.

The first part of the study presented sampling and analytical data from 20 linen and industrial laundries. Samples were collected for untreated wastewater at 15-minute intervals during an 8- to 10-hour period and composited based on the flow rate at the time of sampling. The wastewater flow was calculated from process water meter readings and flow readings in the wastewater treatment system. The process water flows were used to calculate maximum pollutant loadings. These are maximum loadings because all of the water metered into the facility is not discharged as wastewater. The production-normalized pollutant loading level was based on the maximum pollutant loading level and the actual poundage of laundry produced on the sampling days. The types of items laundered on the sampling days were not reported; soil classification provided information on the soil loading only. Also, from the sampling point location information, it was difficult to determine the exact location of the sampling point and the source of wastewater sampled. In some cases, the untreated wastewater sampled may have passed through settling pits or screens before sampling.

The second part of the TRSA study presented data from five linen and industrial laundries. All of these laundries had treatment systems in place. Four facilities had DAF systems and one facility had a proprietary filter system. Sampling was conducted as described for the first part of the study, except that both untreated and treated wastewater samples were collected. Process water flows were used to calculate maximum pollutant loadings, and wastewater flows in the treatment system were used to calculate actual pollutant loadings. The production-normalized pollutant loading level was based on the maximum pollutant loading level and the average poundage of clean, dry laundry produced per week at the facility.

This study included information on the percentages of different types of items laundered at sampled laundries, although no information was provided on the types of articles laundered during the sampling days. Also, the descriptions of the sampling point locations were more extensive than those presented in the first part of the study. Diagrams of the wastewater treatment systems were provided and the operations of the treatment systems were discussed briefly. Several of the facilities sampled experienced difficulties with their treatment system during the sampling days. Also, unlike in the first part of the study, the production-normalized pollutant loading levels were based on average production levels instead of actual production levels.

3.7.2 Trade Associations Solicitation of Data

After the publication of the proposed rule, the industrial laundries trade associations, UTSA and the TRSA, solicited data from all of the facilities that were sent a detailed questionnaire. The purpose of the solicitation, as stated by UTSA and TRSA, was to provide EPA with updated data to calculate new baseline information on the industry, because the EPA questionnaire data are for the 1993 operating year.

The trade associations' solicitation requested the following information: the year the data were supplied, the average flow rate of wastewater, modifications to treatment system since 1993, the year modifications to treatment system occurred, a description of the current wastewater treatment system, the portion of the wastewater treated, the facility's discharge permit limits and the facility's average discharge concentration for 13 parameters, the weekly production of the facility, the average percentage of total pounds per item laundered, whether a subcontractor is used to process towels, the amount of towels subcontracted out for processing, whether the subcontractor water-washes or dry-cleans the towels, and whether the subcontractor's wash water from the laundering of the towels is treated.

Of the 193 facilities that EPA used to model compliance costs and pollutant loading reductions for the proposed rule, 165 responded to the UTSA/TRSA survey. EPA reviewed the data from the survey and compared, for each facility, the treatment system description contained in the UTSA/TRSA solicitation to the treatment system components reported in the detailed questionnaire.

3.7.3 Data Included with Comments on the Proposed Rulemaking and Notice of Data Availability

In response to the proposal published on December 17, 1997 and the NODA published on December 23, 1998, EPA received additional data from the industrial laundries in individual comment submittals. The data received included: industrial laundry effluent loadings, treatment technology costs, the constituents of TPH, data on the analytical variability of bis(2-ethylhexyl) phthalate, local limits for specific laundries, and POTW treatability of specific pollutants. Costs submitted by commenters included: general annual and capital costs for both chemical precipitation and DAF, the annual costs associated with treating 1,000 gallons of wastewater with DAF, analytical costs, the costs associated with the construction of a new building for an industrial laundry, and facility-specific cost information.

The industrial laundries industry and its trade associations also submitted reports and case studies. Reports and studies submitted by commenters ranged in content from data pertaining to the calculation of the toxic weighting factor for TPH to general economic and industry profiles for the industrial laundries industry.

These data are contained in Section 14 of the Industrial Laundries Administrative Record. Data submitted with comments and used by EPA as part of specific analyses are described in more detail in other sections of this document.

3.7.4 Request for Substantiation of Claims Made in Comments

Many of the commenters on the proposed rule stated that EPA underestimated compliance costs and that EPA overestimated the treatment performance of chemical precipitation and DAF. However, many commenters did not present data to substantiate these claims. Without additional data to support these claims, EPA would have to rely on data obtained prior to proposal (vendor quotes, previously submitted cost data and comment

submittals, and sampling data) and data acquired since proposal through EPA's data collection activities.

To obtain data to support unsubstantiated comments made on the proposed rule, EPA contacted some commenters directly to request additional information. EPA developed a set of four questions that requested specific information that would enable EPA to consider the commenter's information in development of the final action.

EPA requested the following information: a diagram presenting the facility's wastewater treatment system, including all treatment units, average and residual flows, chemical addition locations; a description of the facility's operations including total production and item-specific production, average operation days and hours per year; and specific wastewater treatment system capital and annual costs.

To comply with the Paperwork Reduction Act, EPA sent letters to nine of the commenters that submitted unsubstantiated comments. EPA selected commenters to receive letters based on the content of their comments, the number of comments submitted, whether or not the comment was a standard letter prepared by the trade associations, and the size of the firm. The methodology used to select these nine letter recipients and copies of the letters sent to each of them are presented in Section 14.6.1 of the Industrial Laundries Administrative Record. EPA also solicited comments from the public on these issues in the NODA.

3.7.5 The Trade Associations Split-Sampling Efforts

The industrial laundries trade associations split samples with EPA during one of the nine facility sampling episodes (Episode 4900) and several of the Method 1664 Characterization Study sampling episodes. The data collected by the industry during Episode 4900 were supplied to EPA in a comment submittal; these data are located in Section 14 of the Industrial Laundries Administrative Record. The industry did not supply EPA with the split sample data collected during the Method 1664 Characterization Study.

3.8 POTW Data

Several POTWs submitted data and comments that were used for the final action, and are discussed below.

3.8.1 AMSA Questionnaire

The Association of Metropolitan Sewerage Agencies (AMSA), in an effort to assist EPA in collecting data for the development of effluent limitations guidelines and standards for the industrial laundries industry, developed and distributed a questionnaire to its member POTWs in 1993. The questionnaire asked the POTWs to provide already collected data on industrial laundries, which were defined as facilities with the SIC code of 7218 (facilities that supply laundered and dry-cleaned work uniforms, wiping towels, safety equipment (such as gloves, flame-resistant clothing), dust covers and cloths, and other items to commercial and

industrial facilities). The questionnaire asked the POTWs for the following information about the industrial launderers that discharge to their facilities:

- Identify facilities that discharge to the POTW that do industrial laundering on a contract basis (outside of their normal business classification) that are not classified as an industrial laundry (i.e., hotels, hospitals, prisons, etc.);
- Identify whether facilities discharge directly or indirectly to the POTW;
- Specify what numerical discharge standards the POTW applies to industrial laundries (i.e., local limits, category-specific local limits, other limits); and
- Provide the following specific information for each industrial laundry that discharges to the POTW:
  - — Industrial user information (facility location information, average daily wastewater discharge in gallons per day, and permit information);
  - — Industrial discharge sampling information, including the following: whether the sample point contained only industrial laundry wastewater, and, if not, what other types of waste streams; whether the wastewater was treated prior to the sampling point; types of treatment used; and the types of pollution prevention techniques used at the facility; and
  - — Sampling data for each sampling point (either POTW or Industrial User (IU) self-monitoring data) for calendar year 1992 (including parameter, measurement, type of sample, whether an EPA-approved method was used to analyze the sample, and, if not, what type of method was used).

Approximately 280 POTWs returned completed questionnaires. EPA analyzed the data included in the responses to the questionnaires and used the data to evaluate current local limits imposed on industrial laundries. The completed questionnaires are located in Section 6.6 of the Industrial Laundries Administrative Record.

3.8.2 Data Submittals Related to POTWs with Comments on the Proposed Rulemaking and Notice of Data Availability

EPA received comment submittals from numerous commenters pertaining to POTW data related to the pass-through analysis. These commenters included: individual POTWs, local control authorities, and AMSA, along with the industry's trade associations. Individual POTWs primarily provided data related to the following subjects: the method used to measure TPH, estimated POTW pollutant removal efficiencies, influent and effluent

concentration values to be used in the calculation of POTW pollutant removal efficiencies for the pass-through analysis, industrial laundry facility monitoring data, and local limits covering industrial laundries. These data and results of any evaluations of these data are contained in Sections 14 and 17 of the Industrial Laundries Administrative Record, respectively.

3.9 Summary of Literature Searches

EPA conducted several searches of the open literature throughout the development of the rule to provide information on the industrial laundries industry. The sources searched included the following:

- Journal articles and technology brochures (early 1970 through 1986);
- Census of Service Industries, Department of Commerce (1982);
- Computerized databases containing information on treatment technologies for industrial laundries (1986);
- Lists of industrial laundries from various on-line searching methods (1986); and
- POTW and State Water Quality Agency lists (1986).

EPA conducted additional literature searches in 1993 to gather publicly available information on the industrial laundries industry. EPA conducted one literature search to obtain information about industrial laundry wastewater, wastewater treatment technologies, operations, and costs of operations, and also a search to obtain information about printer towels/rags, wipers, and shop towels.

The literature searches focused on the following topics: waste streams, waste treatment technologies, operations, and costs of operation. The following databases were searched:

Database	Description
Water Resources Abstracts	Water resources topics
Waternet	Index of the American Water Works Association Publications
NTIS	Government-sponsored research, development, and engineering reports and analysis
COMPENDEX	Engineering and technology applications
ENVIRONLINE	Environmental Sciences

Database	Description
Pollution Abstracts	Pollution control and research
Books in Print	Books in print, forthcoming books, and books going out of print in the U.S.
LC Mark	Library of Congress catalogued publications
Textile Technology Digest	Worldwide coverage of textiles and related subjects
World Textiles	Textiles in areas of technology and management

As part of the literature search, EPA identified three trade journals important in the industrial laundries industry: Textile Rental, Industrial Launderer, and Laundry News. These journals provide up-to-date information on the industrial laundries industry. EPA conducted regular reviews of these journals during the development of this final action.

EPA conducted a separate literature search for data on pollution prevention in the industrial laundries industry by examining various on-line databases, including EPA's Pollution Prevention Information Exchange System (PIES).

3.10 Summary of Other Data Sources

In developing the industrial laundries effluent guidelines, EPA also evaluated the following existing data sources:

- The Office of Research and Development (ORD) Risk Reduction Engineering Laboratory (RREL) treatability database;
- The Fate of Priority Pollutants in Publicly Owned Treatment Works (50 POTW Study) database;
- The Domestic Sewage Study (DSS);
- Canadian studies; and
- Industrial Pollution Prevention Project.

These data sources and their uses in the development of the final action are discussed below.

3.10.1 Risk Reduction Engineering Laboratory Treatability Database

EPA's ORD developed the RREL treatability database to provide data on the removal and destruction of chemicals in various types of media, including water, soil, debris,

sludge, and sediment. This database contains treatability data from POTWs for various pollutants. This database includes physical and chemical data for each pollutant, the types of treatment used to treat the specific pollutants, the type of wastewater treated, the size of the POTW, and the treatment concentrations achieved. EPA used this database to assess POTW removal efficiencies of various pollutants.

3.10.2 Fate of Priority Pollutants in Publicly Owned Treatment Works Database

In September 1982, EPA published the Fate of Priority Pollutants in Publicly Owned Treatment Works (16), referred to as the 50 POTW Study. The purpose of this study was to generate, compile, and report data on the occurrence and fate of the 129 priority pollutants in 50 POTWs. The report presents all of the data collected, the results of preliminary evaluations of these data, and the results of calculations to determine the following:

- The quantity of priority pollutants in the influent to POTWs;
- The quantity of priority pollutants discharged from the POTWs;
- The quantity of priority pollutants in the effluent from intermediate process streams; and
- The quantity of priority pollutants in the POTW sludge streams.

EPA used the data from this study to assess POTW removal efficiencies of various pollutants.

3.10.3 The Domestic Sewage Study

In February 1986, EPA issued the Report to Congress on the Discharge of Hazardous Wastes to Publicly Owned Treatment Works (17), referred to as the Domestic Sewage Study (DSS). This report, which was based in part on the 50 POTW Study, demonstrated that a significant number of sites discharging pollutants to POTWs were a threat to the treatment capability of these POTWs and were not regulated by national categorical pretreatment standards. Among the unregulated sources were industrial laundries, which at the time were estimated to discharge significant quantities of toxic and hazardous pollutants on a facility-specific basis. During the course of the DSS, EPA contacted a number of state and local agencies to obtain toxic pollutant data and other relevant data. EPA used the information in the DSS in developing the Preliminary Data Summary for the Industrial Laundries Industry (1).

3.10.4 Canadian Studies

EPA studied other sources of data, as described below, to obtain as comprehensive a picture of the industrial laundries industry as possible. One of these sources was the Ministry of the Environment and Energy (MOEE) of Canada. As in the U.S., industrial laundries in Canada have been found to be a source of oil and grease in sewer systems. The MOEE's Municipal/Industrial Strategy for Abatement (MISA) section and the Ontario, Canada industrial laundry associations conducted a survey of Canadian industrial laundries to assess the

amount of oil and grease and other pollutants discharged into sewer systems. The survey was conducted to obtain an overview of the industrial laundries industry, sources of contamination, and treatment used to reduce the pollutant loads to sewers.

The laundries surveyed in this report included industrial laundries, linen establishments, and commercial launderers and excluded retail-only, coin-operated, dry cleaning, and health-care facilities. The industrial laundries processed industrial garments and wiper towels, which, according to this survey, were considered major sources of oil and grease. The survey showed that many industrial laundries in this study used some wastewater pretreatment; however, only four facilities used advanced pretreatment techniques, and several facilities did not pretreat their wastewater.

In addition, the Ontario Laundry Industry Pollution Prevention Task Force has been meeting regularly to discuss pollution prevention measures in the laundries industry and how to promote those practices. The Task Force consists of the following entities: the Ontario Ministry of Environment and Energy, the Metropolitan Area of Toronto, the City of Brantford, and several Canadian laundries, some of which represent the laundry associations Dry Cleaners and Launderers Institute (DCLI) and Textile Rental Institute of Canada (TRIO). In 1994, the Task Force held a workshop on pollution prevention in the laundries industry, which discussed pollution prevention in general, how using pollution prevention practices benefits industrial laundries, and approaches to and techniques for reducing waste in the industry.

3.10.5 Industrial Pollution Prevention Project

EPA has undertaken several pollution prevention-related activities involving the industrial laundries industry. Some of the efforts were Agency-wide, including ORD and EPA's Region IX, while other efforts were part of the engineering studies in the development of the proposed rule.

The Agency-wide efforts, called the Industrial Pollution Prevention Project (IP3), were multimedia and examined how industrial pollution prevention can be incorporated into EPA's regulatory framework and how the pollution prevention ethic can be promoted throughout industry, the public, and government. A report summarizing the results of these efforts, entitled Industrial Pollution Prevention Project (IP3) - Summary Report (18), included the results of two case studies involving industrial laundries. More detailed discussions of the two studies are contained in the individual reports, Pollution Prevention at Industrial Laundries: Assessment Observations and Waste Reduction Options (19), and Pollution Prevention at Industrial Laundries: A Collaborative Approach in Southern California (20). These studies identified a number of "best management practices" (BMPs) and water and energy savings technologies as potential pollution prevention at industrial laundries.

Similarly, during the engineering study phase of the development of a final action, EPA identified a number of potential pollution prevention practices and technology applications. Section VI of the preamble to the proposed rule and Chapters 6 and 8 of this document discuss the pollution prevention technologies and practices and their uses with respect to the final action.

3.11 References

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18. U.S. Environmental Protection Agency. Industrial Pollution Prevention Project (IP3)-Summary Report. EPA-820-R-95-007, July 1995.

19. U.S. Environmental Protection Agency. Pollution Prevention at Industrial Laundries: Assessment Observations and Waste Reduction Options. EPA-820-R-95-010, July 1995.

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CHAPTER 4

INDUSTRY PROFILE

4.1 Introduction

Chapter 4 discusses the processes, items, customers, chemicals, facilities and equipment, and pollution reduction activities found in the industrial laundries industry. This chapter also provides a definition of the industrial laundries industry. Most of the data presented in this chapter are from facility responses to the 1994 Industrial Laundries Industry Questionnaire (detailed questionnaire), additional data are from the 1993 Industrial Laundries Screener Questionnaire. EPA sent the detailed questionnaires to 250 facilities, and 231 facilities returned the questionnaire, as described in Section 3.3.2 of this document. Two hundred eight (208) facilities that responded to the detailed questionnaire provided sufficient data to perform complete technical and economic analyses. The percentages and number of facilities performing various processes discussed in this section were estimated based on the responses from all facilities determined to be industrial laundries. The data for these facilities were then extrapolated to represent the industry population of 1,747 facilities, using appropriate survey weights. The survey weights calculated for each of the facilities can be found in the Statistical Support Document for the proposed rule (1). Three facilities of the 193 identified industrial laundries were later determined to be out-of-scope because they process only clean room items (see Section 4.8). The following topics are discussed in this section:

- Section 4.2 discusses the geographic location, relative size, types of items laundered, customers, and Standard Industrial Classification (SIC) code distribution of facilities in the industrial laundries industry;
- Section 4.3 discusses general information on industrial laundering processes and chemicals used in the laundering processes;
- Section 4.4 discusses facilities and equipment used at industrial laundries;
- Section 4.5 presents pollution reduction activities;
- Section 4.6 discusses trends within the industry;
- Section 4.7 lists treatment technologies in use;
- Section 4.8 provides EPA's definition of the industry; and
- Section 4.9 presents the references used in this section.

4.2 Overview of the Industry

This section provides an overview of the industrial laundries industry. This overview includes general information pertaining to the industry, including geographic location, SIC codes, facility size, types of items laundered, and customers.

4.2.1 Geographic Distribution of Facilities

Information on geographic distribution was based on the 1993 Industrial Laundries Screener Questionnaire. This questionnaire was completed by 1,500 industrial laundries that EPA identified using trade association mailing lists. Since there were no direct discharging industrial laundries identified by the questionnaire responses, only industrial laundries that reported generating laundry process wastewater and discharging a wastewater to a publicly owned treatment works (POTW) were used to determine the geographic distribution of facilities. These facilities are located in all 50 states and in all 10 EPA Regions, as well as several U.S. territories. Figure 4-1 and Table 4-1 present the geographic distribution of these facilities. By state, the greatest number of in-scope laundries (102 facilities) are in California. By EPA region, the greatest number of in-scope laundries (203 facilities) are in Region V, followed by Region IV, which has 181 facilities. Most of the laundries are located in large urban areas.

4.2.2 SIC Codes Reported

The facilities responding to the detailed questionnaire reported 7218 (Industrial Laundries) and 7213 (Linen Supply Laundries) as their primary SIC codes. Other secondary and tertiary SIC codes reported were 7211 (Power Laundries, Family and Commercial), 7216 (Dry-cleaning Plants, except rug cleaning), and 7219 (Laundry and Garment Services, not elsewhere classified).

4.2.3 Facility Size

Industrial laundries vary in size from one- to two-person shops to large corporations that operate many facilities nationwide. For the purpose of this section, EPA based the relative size of each facility on the pounds of dirty (as-received) laundry washed per year.

Table 4-2 presents the national estimates of the number of industrial laundries by production category. Annual laundry production per facility ranges from 44,100 to 32,600,000 pounds and the total annual industry production is 9,360,000,000 pounds. Although there are a fewer percentage of large facilities exist (more than 15 million pounds/year (lbs/yr) production) than small facilities (less than 1 million lbs/yr production), the larger facilities represent a significant percentage of the total industry production. One hundred thirty-eight (138) facilities launder more than 15 million lbs/yr each. These facilities represent 8 percent of the facilities in the industry, but their combined production (2,660,000,000 lbs/yr) accounts for 28 percent of the total industry production. Facilities laundering less than 1 million lbs/yr represent 10 percent of the facilities in the industry and account for less than 1 percent of the total industry production.

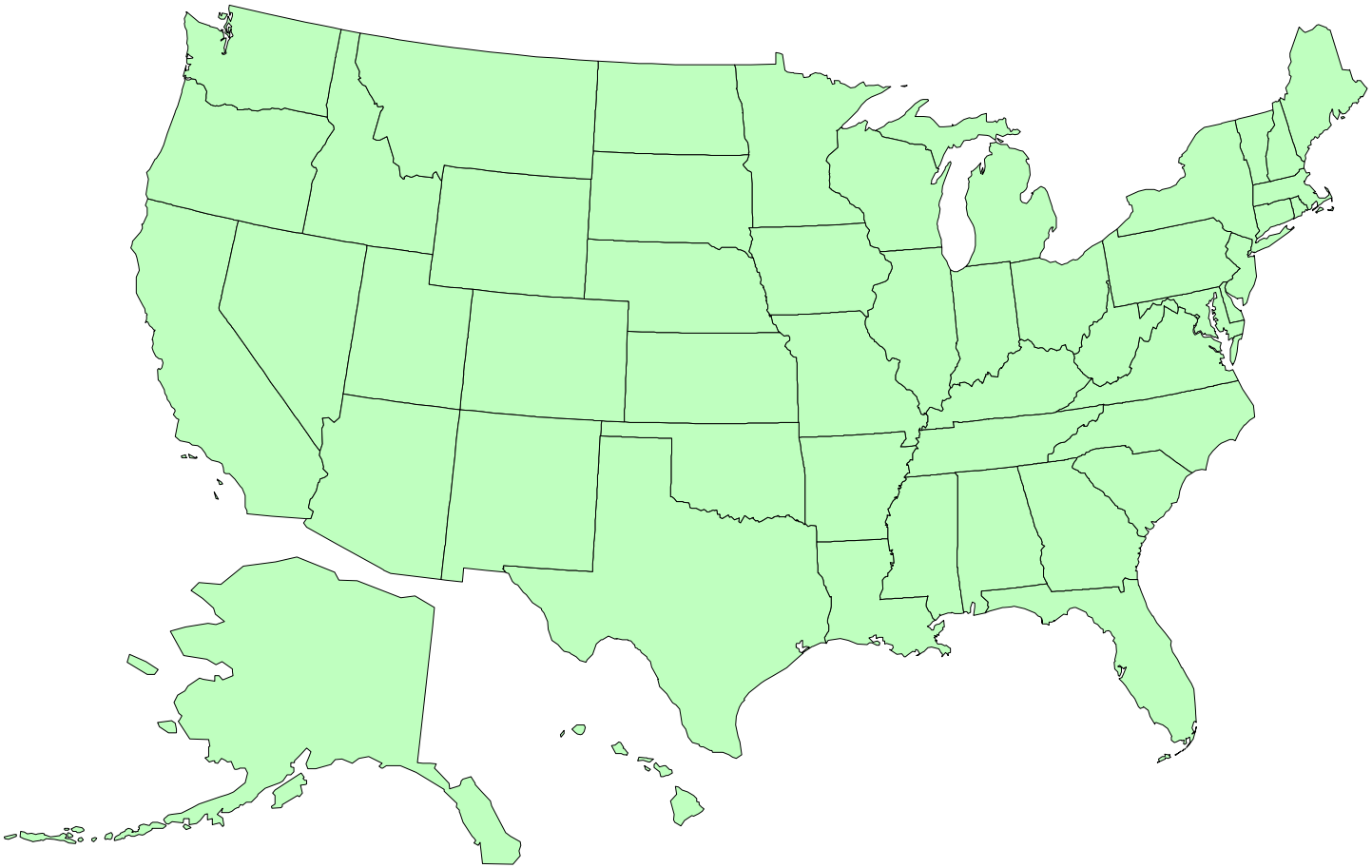

Figure 4-1. Geographic Distribution of Industrial Laundries

Table 4-1

Geographic Distribution of Industrial Laundries by EPA Region and State

Region/State	Number of Facilities in Region/State[1]
Region I	**55**
Connecticut	11
Maine	4
Massachusetts	29
New Hampshire	6
Rhode Island	4
Vermont	1
Region II	**72**
New Jersey	19
New York	51
Puerto Rico	2
Region III	**101**
Delaware	4
District of Columbia	3
Maryland	17
Pennsylvania	49
Virginia	21
West Virginia	7
Region IV	**181**
Alabama	14
Florida	42
Georgia	28
Kentucky	27
Mississippi	6
North Carolina	35
South Carolina	13
Tennessee	16
Region V	**203**
Illinois	42
Indiana	33
Michigan	36

Table 4-1 (Continued)

Region/State	Number of Facilities in Region/State[1]
Minnesota	17
Ohio	56
Wisconsin	19
Region VI	**131**
Arkansas	18
Louisiana	16
New Mexico	10
Oklahoma	15
Texas	72
Region VII	**57**
Iowa	14
Kansas	8
Missouri	24
Nebraska	11
Region VIII	**36**
Colorado	16
Montana	3
North Dakota	1
South Dakota	4
Utah	6
Wyoming	6
Region IX	**136**
Arizona	14
California	102
Guam	3
Hawaii	8
Nevada	9
Region X	**39**
Alaska	4
Idaho	8
Oregon	14
Washington	13

[1]Number of facilities is based on number of facilities identified by the 1993 Industrial Laundries Screener Questionnaire that reported generating laundry process wastewater and discharging that wastewater to a POTW.

Table 4-2

Industrial Laundry
Size Distribution

Production Category (lbs/yr)	Estimated Number of Facilities[1]	Estimated Percentage of Total Number of Facilities Reporting Production Data	Total Estimated Production for this Category (lbs/yr)	Estimated Percentage of Total Production
< 1,000,000	167	10	76,600,000	<1
1,000,000 to < 3,000,000	475	27	886,000,000	10
3,000,000 to < 6,000,000	629	36	2,740,000,000	29
6,000,000 to <9,000,000	199	11	1,390,000,000	15
9,000,000 to < 15,000,000	139	8	1,600,000,000	17
> 15,000,000	138	8	2,660,000,000	28
Total	1,747	100	9,360,000,000	100

[1]Number of facilities is estimated using the detailed questionnaire, based on 193 in-scope facilities extrapolated to represent the entire industry (including three facilities that were later determined to be out-of-scope because they process only clean room items).
Source: 1994 Industrial Laundries Industry Questionnaire.

4.2.4 Items Laundered

As reported by the 193 facilities, industrial laundries wash a variety of items. The three main types of items reported in the detailed questionnaire responses were industrial laundry items, linen laundry items, and other items. Typically, industrial laundry items include industrial garments, shop towels, printer towels, floor mats, and fender covers. Linen items typically include linen garments, flatwork/full dry linen, and health-care items. Other items are specialty items or items that are not generally considered to be either industrial laundry items or linen items. Brief descriptions of industrial laundry, linen items, and other items are provided in Chapter 5 of this document.

Table 4-3 presents the number of facilities that launder each item and the percentage of total production by item. Many facilities reported laundering several items. The total extrapolated item-specific production reported in the detailed questionnaire is 9,360,000,000 lbs/yr (calculated by summing the item-specific subtotals reported in the detailed questionnaire and extrapolating the data to represent the entire industry).

The detailed questionnaire requested production data for twelve specific items (questionnaire category codes B01 through B12), as listed on Table 4-3. EPA requested facilities to report any items laundered that did not fall in the B01 through B12 categories and place them in category B13 (Other Items). Based on item types and descriptions provided by the facilities, EPA created supplemental categories B14 through B24 for these "other" B13 items. Items that could not be classified in categories B14 through B24 remained in the B13 "other" category. Because the data for category codes B13 through B24 were collected through "write-in" responses rather than through pre-printed selections, EPA believes that the data for category codes B13 through B24 may not represent total industry production for the items identified in these categories.

4.2.5 Customers

Industrial laundries wash items for many different types of customers, ranging from gasoline stations to restaurants. The pollutants present on an item laundered depend primarily on the customer who used the item and the specific use of the item. For instance, a shop towel from a gasoline station is more likely to have a high concentration of oil and grease or total petroleum hydrocarbon than a napkin from a restaurant. Table 4-4 lists the laundered items reported in the detailed questionnaire responses, the typical customers using these items, and the percentage of the total industry production of each item laundered from each customer. For example, automobile repair, services, dealers, and gas stations represent 31.1 percent of the customers who use industrial garments.

Table 4-3

Types of Items Laundered

Item Type[1]	Estimated Number of Facilities Laundering Item	Estimated Percentage of Total Facilities	Estimated Percentage of Total Production[2]
Industrial Garments (B01)	1,441	82.5	24.4
Shop Towels, Industrial Wipers, etc. (B02)	1,332	76.2	3.7
Printer Towels (B03)	480	27.5	1.4
Floor Mats (B04)	1,644	94.1	19.3
Mops, Dust Cloths, Tool Covers, etc. (B05)[3]	1,400	80.1	1.3
Linen Garments (B06)	942	53.9	2.9
Linen Flatwork/Full Dry Linen (B07)	1,364	78.1	35.2
Health-Care Items (B08)	648	37.1	7.9
Fender Covers (B09)	687	39.3	<1
Continuous Roll Towels (B10)[3]	927	53.1	1.2
Clean Room Garments (B11)	28	1.6	<1
Clean Wipes (B12)	-	-	-
Other Items (B13)[4]	31	1.8	<1
Laundry Bags (B14)	28	1.6	<1
Family Laundry (B15)	84	4.8	<1
Absorbents (B16)	-	-	-
New Items (B17)	74	4.2	1.6
Executive Wear (B18)	43	2.5	<1
Miscellaneous Not Our Goods (NOG) (B19)	14	< 1	<1
Rewash Items (B20)	38	2.2	<1
Airline Carpet and Seat Covers (B22)	-	-	-
Filters (B23)	7	< 1	<1
Buffing Pads (B24)	6	<1	<1
Total	**-**	**-**	**100**

[1]The codes in parentheses are from the detailed questionnaire and were used in the questionnaire database.
[2]Total industry production is estimated based on data from the detailed questionnaire from the 193 in-scope facilities, extrapolated using appropriate survey weights to represent the entire industry (including three facilities that were later determined to be out-of-scope because they process only clean room items).
[3]One facility (with a survey weight of 1.3333) did not report production for this item; therefore, the estimated percentage of total production may be less than the actual amount processed.
[4]Includes items not specified in detailed questionnaire responses.
Source: 1994 Industrial Laundries Industry Questionnaire.

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Table 4-4

Typical Customers for Each Type of Item Laundered

Item Type[1]	Customers[1]	Percentage of Total Production of Item from Customer[2]
Industrial Garments (B01)	- Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Special Trade Contractors for Building Construction (C02) - Dwellings and Other Building Services (C03) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Chemicals and Allied Products Manufacturing (C05) - Transportation, Communication, Utility, and Sanitary Services (C07) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08)	31.1 10.2 5.49 17.2 9.65 10.5 11.1
Shop Towels, Industrial Wipers, etc. (B02)	- Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Special Trade Contractors for Building Construction (C02) - Dwellings and Other Building Services (C03) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Chemicals and Allied Products Manufacturing (C05) - Transportation, Communication, Utility, and Sanitary Services (C07)	48.1 6.74 5.14 19.6 7.52 6.12
Printer Towels (B03)	- Publishing and Printing Industries (C06) - Other Laundries (C20)	86.1 13.4
Floor Mats (B04)	- Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Dwellings and Other Building Services (C03) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Chemicals and Allied Products Manufacturing (C05) - Transportation, Communication, Utility, and Sanitary Services (C07) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08)	26.8 11.0 11.4 5.92 6.63 24.7
Mops, Dust Cloths, Tool Covers, etc. (B05)	- Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Dwellings and Other Building Services (C03) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Transportation, Communication, Utility, and Sanitary Services (C07) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08) - Health Services (C10)	15.4 23.1 8.17 7.37 20.2 7.46

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Table 4-4 (Continued)

Item Type[1]	Customers[1]	Percentage of Total Production of Item from Customer[2]
Linen Garments (B06)	- Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08)	91.1
Linen Flatwork/Full Dry (B07)	- Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08) - Hotel and Lodging Establishments (C09)	85.2 14.1
Health-Care Items (B08)	- Health Services (C10) - Customer Not Reported (C11)[3]	90.8 8.65
Fender Covers (B09)	- Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Transportation, Communication, Utility, and Sanitary Services (C07)	77.1 11.6 8.24
Continuous Roll Towels (B10)	- Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Special Trade Contractors for Building Construction (C02) - Dwellings and Other Building Services (C03) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Transportation, Communication, Utility, and Sanitary Services (C07) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08)	21.1 7.31 8.33 9.51 9.23 29.2
Clean Room Garments (B11)	- Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Chemicals and Allied Products Manufacturing (C05) - Customer Not Reported (C11)[3] - Electronics Industry (C18)	17.2 21.2 28.2 30.3
Laundry Bags (B14)	- Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Special Trade Contractors for Building Construction (C02) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Publishing and Printing Industries (C06) - Transportation, Communication, Utility, and Sanitary Services (C07) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08)	23.7 9.34 5.82 7.52 39.2 9.25
Family Laundry (B15)	- Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08) - Families (C23)	8.92 8.33 69.8

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Table 4-4 (Continued)

Item Type[1]	Customers[1]	Percentage of Total Production of Item from Customer[2]
Absorbents (B16)	- Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Publishing and Printing Industries (C06) - Retail/Wholesale Stores (C12) - Miscellaneous Service Industries (C15) - Agricultural Industry (C16) - Miscellaneous Manufacturing (C19)	13.2 6.79 19.3 19.9 5.61 16.8
New Items (B17)	- Retail/Wholesale Stores (C12) - Miscellaneous Manufacturing (C19) - Textile Manufacturing (C24)	31.8 27.2 41.0
Executive Wear (B18)	- Other Laundries (C20) - General Offices (C21) - Families (C23)	56.3 36.2 5.47
Miscellaneous Not Our Goods (NOG) (B19)	- Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08)	96.0
Rewash Items (B20)	- Transportation, Communication, Utility, and Sanitary Services (C07)	94.0
Filters (B23)	- Chemicals and Allied Products Manufacturing (C05) - Wood Product/Furniture Manufacturing (C14)	17.3 82.7
Buffing Pads (B24)	- Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08)	100

[1]The codes in parentheses are from the detailed questionnaire and were used in the questionnaire database.
[2]Customers representing less than 5 percent of the total production for an item are not shown in the table; therefore, the percentages may not add up to 100 percent for each item.
[3] Production data were provided for these items; however, the percentage of customers not reported by the facilities was greater than 5 percent.
Source: 1994 Industrial Laundries Industry Questionnaire.

4.3 Laundering Processes

For all laundering processes, the methods by which the items are received, sorted, and transported to the washing area are similar. Industrial laundries receive soiled items in trucks and weigh the items before washing. These items are typically sorted based on item type, fabric type, color, degree and/or type of soil, and ownership. Sorted items are then placed in slings or carts, which are either automatically or manually moved to the washing area. The items are then cleaned using the appropriate process.

Table 4-5 presents laundering processes reported by the facilities responding to the detailed questionnaire, as well as the percentage of total production laundered by each process and the number of facilities performing each process. Many facilities reported conducting more than one of the listed processes. One process included in Table 4-5, dyeing of new fabrics is not considered a laundering process by EPA. EPA reviewed laundry processes and associated water use and wastewater discharge practices to determine if facilities that used and/or discharged little or no water could be eliminated from the scope of the rule. Only water-washing laundering processes are included in the scope of the rule. EPA does not consider dyeing of new items to be a laundering process; therefore, it is also excluded from the scope of the proposed rule. Dyeing of used textile items such as shop and printer towels/rags, which is often performed as part of the washing process, is included in the scope of the rule. The remaining processes listed in Table 4-5 can be divided into two basic categories: processes that generate wastewater and processes that generate little or no wastewater. The individual processes within these categories are described in more detail below.

4.3.1 Water-Using/Wastewater-Generating Processes

Laundering processes that use significant amounts of water and generate wastewater include water-washing processes and dual-phase washing. Almost all (97 percent) of the industry's production involves water-washing processes. Of the 1,747 in-scope facilities (including three facilities that were later determined to be out-of-scope because they process only clean room items), EPA estimates that 1,443 perform water washing on 100 percent of their production. Water washing is performed on almost all items. Brief descriptions of the different water-using processes are provided below.

4.3.1.1 Water Washing

Water washing involves the washing of soiled items in a water/chemical solution. The concentration, type, and amount of chemicals added during the water-washing process depend on the item type and the degree to which items are soiled. Wash formulas are used to determine the different washing cycles used in water washing, including the chemicals added. Wash formulas are also used to set the order, number, and duration of each wash cycle that is performed during the water-washing process. The typical order of these cycles and brief descriptions of the processing operations that occur in each cycle are described below.

Table 4-5

Laundering Processes Reported in the Detailed Questionnaire

Process[1]	Estimated Number of Facilities Performing the Process	Estimated Percentage of Facilities Performing the Process	Estimated Percentage of Total Production[2]
Water Washing (A01)	1,725	99	97
Dual-Phase Washing - Petroleum solvent wash followed by water washing (A02)	18	1	<1
Dual-Phase Washing - Water wash followed by perchloroethylene solvent wash (A03)	0	0	0
Dry Cleaning - Charged system (A04)	125	7	<1
Dry Cleaning - Fresh soap added to each load (A05)	80	5	<1
Dry Cleaning - No soap added (A06)	80	5	<1
Dry Cleaning Followed by Water Washing (drying between steps) (A12)	29	2	<1
Dust Control Mop Treatment - Water wash followed by oil treatment applied outside wash wheel (A10)	692	40	1
Dust Control Mop Treatment - Water wash followed by oil treatment applied inside wash wheel (A11)	67	4	<1
Dust Control Mop Treatment- Water wash followed by unspecified oil treatment (A07)	22	1	<1
Dust Control Mop Treatment - Oil only (A08)	57	3	<1
Stone/Acid Washing of Denim (A13)	11	1	1
Dyeing (A14)[3]	1	<1	<1
Total	-	-	100

[1]The codes in parentheses are from the detailed questionnaire and were used in the questionnaire database.
[2]Percentages reported are estimated based on the 193 in-scope facilities (including three facilities that were later determined to be out-of-scope because they process only clean room items), extrapolated using appropriate survey weights to represent the entire industry.
[3]This process is not considered a laundering process by EPA.
Source: 1994 Industrial Laundries Industry Questionnaire.

In typical water-washing processes, the first cycle is the flush, which is defined as any rinsing operation prior to bleaching. This cycle removes loosely attached solids and a portion of the water-soluble soils. The next cycle is the break, during which items are treated with an alkali solution that swells the cellulosic fibers, allowing the soil to be more readily removed. Detergents may also be added during the break cycle. Sudsing occurs after the break cycle and is the cycle in which the actual washing of the items occurs. During sudsing, detergent is added in varying concentrations and the items are agitated until they are clean. After sudsing, a bleaching cycle may be performed, during which the detergent is replaced with a bleach solution and agitation continues. Following the sudsing and bleaching cycles, a rinsing cycle is typically performed, which removes the excess alkali and soap from the items. Additional chemicals are added in the blueing/brightening cycle to whiten/brighten the items. The final operation in water washing is the finish, which involves souring or acidifying the final bath water to a pH of 5, which prevents the yellowing of fabrics by sodium bicarbonate during pressing.

4.3.1.2 Dual-Phase Processing

Some facilities combine the water-washing and dry-cleaning processes to wash items that have large amounts of both organic-solvent-soluble and water-soluble soils. When these processes are performed in series, without drying the item between the solvent and water phases, the process is called dual-phase processing. The order in which these processes are carried out is determined by the solvent used, type of soil, and drying energy requirements. Dual-phase processing involving a petroleum solvent wash followed by water washing is used by only one percent of the industry. None of the facilities responding to the detailed questionnaire reported performing dual-phase processing involving water washing followed by solvent wash.

4.3.1.3 Water-Washing of Mops

This process entails first water washing mops and then applying oil to the mops by a sprayer either outside or inside the washer. This method of washing mops generates wastewater.

4.3.2 Processes with Minimal Wastewater Discharge

There are several laundering processes that generate minimal to no wastewater. Dry cleaning is a processes that generates minimal amounts of wastewater. Data from the detailed questionnaire indicate water use associated with dry cleaning typically ranges from zero gallons of process water per pound of laundry processed to 0.25 gallons of process water per pound of laundry processed. (Water use associated with water washing ranges between 1.5 and 3.6 gallons of process water per pound of laundry, for over 60 percent of the industry.) Dust control mop treatment using only oil is the only industrial laundry process that generates no wastewater. Each of the processes represents less than one percent of the total industry production and is described in more detail below.

4.3.2.1 Dry Cleaning

Dry cleaning involves the use of an organic solvent instead of an aqueous detergent solution to clean laundry items. Water washing of certain items causes hydrophilic fibers to swell and undergo dimensional changes, causing wrinkles and shrinkage that can be avoided by the use of dry-cleaning solvents. These solvents dissolve soils at low temperatures and under relatively mild conditions, unlike water washing, which usually involves high temperatures and the use of harsh chemicals, such as alkalis and bleaches. The primary solvents used by industrial laundries are perchloroethylene ("perc") and petroleum-based solvent. Because these solvents are typically expensive and are considered hazardous wastes, they are commonly recycled and reused in subsequent dry-cleaning loads. During dry cleaning, the solvent becomes contaminated with dirt, oil, and grease removed from the items processed. To minimize the solvent contamination, industrial laundries use multiple solvent rinses to process items. As with water washing, the first few rinses typically contain the most pollutants, and subsequent rinses become less contaminated.

The general process steps for dry cleaning are similar to those for water washing. The items may be washed and dried in the same unit or washed in one unit and manually transferred to a dryer. In the drying step, steam is injected into the unit to volatilize the solvent. The steam and solvent are captured in a condenser. The water/solvent mixture is transferred to a phase separator where the solvent and water are separated. The solvent is either reused or contract hauled off-site for disposal. The water is discharged to a POTW either with or without pretreatment. The three major methods of dry cleaning items at industrial laundries are listed below.

1) Charged system: A small percentage of water and detergent (between 0.5 percent and 4 percent) is added to the dry-cleaning solvent. The water and detergent concentration in the solvent is maintained throughout the washing processes by using conductivity meters to control the addition of water and detergent automatically.

2) Fresh soap added to each load: A given amount of soap or detergent is added at the beginning of each load; no additional detergent is added during the cleaning cycle. Because the process is not monitored as closely as the charged system, excess water, soap, and energy may be expended with this system.

3) No soap added: This method uses only a dry-cleaning solvent.

4.3.2.2 Oil Treatment of Dust Mops

At some facilities, dust mops are not water-washed but are cleaned and treated with heated oil instead of water. After cleaning, the oil is extracted from the mops, leaving them coated with the desired quantity of treatment oil. The dirty oil is then purified by filtration and is reused. This is a closed-loop processing system that uses no process water.

4.3.3 Chemicals Used in Industrial Laundries

Industrial laundries use a variety of chemicals in their laundering processes. Chemicals that are frequently added to wash formulas include:

- Alkaline solution - to swell the fibers in the items;
- Detergent - to remove soil from the items (including sodium hypochlorite and hydrogen peroxide);
- Bleach - to brighten the items (including sodium sulfites);
- Antichlor - to remove excess bleach from the items;
- Sour - to reduce the pH of the water to prevent yellowing of the items (including acetic acid and sodium silica fluorides);
- Softener - to soften the items; and
- Starch - to finish the items.

A variety of other chemicals are added to some wash formulas, including enzymes, builders, oil treatment chemicals, water conditioners, dyes, stain treatment chemicals, and bactericides.

Table 4-6 lists, based on the detailed questionnaire, the types of chemicals that are added during laundering operations, the number of facilities that add each chemical, the amount of each chemical added per year and the number of facilities that reported using the chemical but did not report the amount of the chemical used. Facilities that did not report chemical amounts were included in the number of facilities that added the chemicals, but they were not reflected in the amounts of chemicals added per year. As shown in Table 4-6, the two chemicals added most frequently to industrial laundering processes (besides detergent) are bleach and sour. The majority of the facilities (89 percent) use bleach as part of their laundering process. Eighty-one percent of the facilities use sour to prevent the yellowing of laundered items.

Some facilities reported using a chemical for more than one purpose. For these facilities, Table 4-6 includes only the primary purpose of the chemical. The amounts of mop oil treatment and dry cleaning solvents listed in Table 4-6 are lower than actual use because many respondents who reported conducting mop oil treatment or dry cleaning processes did not report the amounts of chemicals used in these processes.

Table 4-7 presents the average amount of detergent added per 1,000 pounds of laundry for the items laundered in the greatest amounts. Buffing pads, filters, shop towels, and printer towels require on average the highest amounts of detergent per pound of laundry, whereas health-care items and floor mats require significantly less detergent per pound of laundry.

4.4 Facilities and Equipment

Table 4-8 presents the history of industrial laundries construction and startup from before 1940 to 1995. Facility construction refers to the year the building that the facility operates in was built. Facility startup refers to the year that actual industrial laundry processing began. As shown in the table, construction of laundries has fluctuated to some degree over the years. In the 1940s, construction of facilities dipped, then rose in the 1960s, and has declined somewhat into

Table 4-6

Industrial Laundering Wash Formula Chemicals Reported in the Detailed Questionnaire

Type of Chemical	Estimated Number of Facilities Adding Chemical	Total Estimated Amount Added (gal/yr)[1]	Total Estimated Amount Added (lb/yr)[1]
Detergent	1,742	3,923,590	105,087,072
Bleach	1,562	5,603,861	3,768,844
Sour	1,419	639,586	4,942,014
Antichlor	1,059	200,546	2,144,738
Softener/Antistatic	990	329,038	1,074,365
Starch	972	198,754	8,741,770
Alkaline Solution	547	2,018,373	7,256,211
Mildewcide/Bactericide	533	81,304	955,824
Solvent-Based Detergent	470	530,513	0
Dye Products	436	46,127	456,012
Builder	275	851,861	1,962,176
Oil Treatment Chemical	258	1,552,455	33,314
Stain Treatment Chemical	157	3,879	124,059
Water Conditioner	141	53,920	1,467,531
Miscellaneous Others[2]	105	239,056	32,140
Solvent (Dry Cleaning)	116	244,278	0
Enzymes	55	861	42,160
Denim Treatment	9	23,018	12,874

[1]Some facilities reported using a specific type of chemical but did not provide the amount added per year. Therefore, the total amounts added per year do not necessarily represent the total industry chemical use. In the detailed questionnaire, facilities were given the choice of reporting the amount of a chemical in either pounds per year or gallons per year.
[2]This category includes chemicals such as pH adjustors, lubricants, fabric coatings, emulsifiers, dispersants, and desizers.
Source: 1994 Industrial Laundries Industry Questionnaire.

Table 4-7

Amounts of Detergent Added Per 1,000 Pounds of Laundry for Items Most Often Laundered

Item[1]	Average Gallons of Detergent Added per 1,000 Pounds of Laundry[2]	Average Pounds of Detergent Added per 1,000 Pounds of Laundry[2]
Industrial Garments (B01)	1.66	23.5
Shop Towels, Industrial Wipers, etc. (B02)	11.2	32.2
Printer Towels (B03)	23.7	35.5
Floor Mats (B04)	0.393	5.37
Mops, Dust Cloths, Tool Covers, etc. (B05)	2.59	21.3
Linen Garments (B06)	2.23	21.2
Linen Flatwork/Full Dry (B07)	1.77	22.8
Health-Care Items (B08)	0.575	8.98
Fender Covers (B09)	1.89	23.0
Continuous Roll Towels (B10)	1.23	14.2
Clean Room Garments (B11)	2.99	12.3
Other (B13)	0.500	---
Laundry Bags (B14)	---	20.2
Family Laundry (B15)	0.667	12.4
New Items (B17)	0.696	6.05
Executive Wear (B18)	1.36	8.65
Miscellaneous NOG (not our goods) (B19)	7.71	---
Rewash Items (B20)	---	31.4
Filters (B23)	---	48.6
Buffing Pads (B24)	48.9	---

[1]The codes in parentheses are from the detailed questionnaire and were used in the questionnaire database.
[2]Facilities were given the choice of reporting the amount of detergent in either pounds per year or gallons per year. These averages reflect the average amount of detergent added, for facilities/formulas that add either liquid detergent or powdered detergent, not a combination of the two.
Source: 1994 Industrial Laundries Industry Questionnaire.

Table 4-8

Age of Facilities and Startup of Laundry/Dry-Cleaning Operations (Estimated Percentage of Total Facilities in Each Time Period)

Time Period	Estimated Number of Facilities Constructed[1]	Estimated Number of Facilities Starting Laundry or Dry-Cleaning Operations
Before 1940	478 (27%)	385 (22%)
1940-1949	108 (6%)	107 (6%)
1950-1959	199 (11%)	192 (11%)
1960-1969	318 (18%)	365 (21%)
1970-1979	207 (12%)	247 (14%)
1980-1989	178 (10%)	274 (16%)
1990-1995	113 (6%)	164 (9%)
Not Specified	147 (8%)	14 (<1%)
Total[2]	1,747 (100%)	1,747 (100%)

[1]Percentages reported are estimated based on the 193 in-scope facilities, extrapolated using appropriate survey weights to represent the entire industry (including three facilities that were later determined to be out-of-scope because they process only clean room items).
[2]Totals may not equal 100% due to rounding.
Source: 1994 Industrial Laundries Industry Questionnaire.

the 1990s. The time periods for the start of laundering operations generally parallel the facility construction time periods.

Industrial laundries typically operate five days per week with one or two shifts per day. Based on information provided in responses to the detailed questionnaire, the average number of operating hours per day is 11 (the range is 5 to 24 hours) and the average number of operating days per year is 261 (the range is 203 to 365 days).

The types of laundering equipment used at these facilities include washing equipment, drying equipment, and finishing equipment. In addition, some facilities have machines specially designed to launder specific items, such as continuous roll towels, mats and rugs, and mops. The most common types of washing equipment used in the industry are washers, extractors, washer-extractors, tunnel washers, and dry-cleaning units; descriptions of these five equipment types are provided below.

4.4.1 Washers, Extractors, and Washer-Extractors

Washers in industrial laundries wash and rinse items without removing excess water. Extractors remove excess rinse water from items after laundering or, in some cases, remove excess liquids from dirty items. Some washers automatically deposit the wash load into adjacent extractors, but others must be emptied manually at the completion of the washing cycle and the laundry transferred into an extractor. Washer-extractors come equipped with an internal extractor where both the washing and extraction of excess liquids occurs in one machine.

Conventional washers used in industrial laundries can handle loads of 15 to 1,200 pounds, as reported by facilities responding to the detailed questionnaire. The average capacity reported by facilities in the detailed questionnaire is 421 pounds per load. A conventional washer consists of a perforated horizontal cylinder rotating in a shell. The cylinder is equipped with ribs that lift the items as the cylinder rotates and drops them back into the washing solution. Conventional washers are traditionally equipped with thermometers for temperature control, gauges for control of water levels, timers, and devices to reverse the direction of rotation every four or five revolutions.

4.4.2 Tunnel Washers

Tunnel washers are washers that operate in a continuous mode. In a tunnel washer, the items move forward through the washer by an “Archimedes screw” arrangement. Rinse water at the discharge end of the washer is recycled back to the first section of the washer. Water, steam, and laundry chemicals are mechanically injected into the washer, and, following washing, the load is moved by conveyer to extractors and dryers.

4.4.3 Dry-Cleaning Units

Dry-cleaning units are similar to those used in water washing, except that the fabrics are cleaned in an organic solvent instead of a detergent solution. Standard dry-cleaning equipment consists of a rotating cylinder in a stationary shell and one or more solvent storage

tanks, a filter system for cleaning the solvent as it is used, a solvent/water separator, distillation equipment for solvent purification, and often a device for recovering solvent vapors (a condenser or an activated carbon filter). The water separated from the solvent is discharged with other process wastewater.

4.4.4 Equipment Use and Age

Tables 4-9 and 4-10 present information on the types of laundry process equipment reported by industrial laundries and the age of this equipment, respectively. As shown in Table 4-9, 95 percent of the facilities have washer-extractors and 42 percent of the facilities own separate washers and extractors. Overall, separate washers and extractors are slightly older than washer-extractors. Facilities reported few tunnel washers and, of those reported, most were purchased in the 1980s or 1990s. Most of the dry-cleaning units reported were also purchased in the 1980s and 1990s. Table 4-10 indicates that, in 1993, 68 percent of all laundry equipment was reported to be 15 years old or less, even though only 16 percent of the facilities were built in the past 15 years and only 25 percent of the facilities started laundering operations in the past 15 years.

4.5 Pollution Reduction Activities

Based on the detailed questionnaire responses, extrapolated to represent the entire industry, 503 facilities have a written pollution reduction policy. Seven hundred forty (740) facilities of the 1,747 extrapolated facilities conduct pollution prevention activities prior to the laundering process (preprocess activities) and 473 of these facilities conduct pollution prevention activities during the laundering process (in-process activities).

Tables 4-11 and 4-12 list the types of preprocess and in-process pollution prevention activities, respectively, reported in responses to the detailed questionnaire. Chapter 6 of this document discusses these activities in greater detail. Although the detailed questionnaire specifically requested that wastewater treatment and water reuse/reduction information not be reported in response to these particular questions, several facilities provided this information. (Water reuse/reduction information was specifically requested by the detailed questionnaire in a different section and is discussed in greater detail in Chapter 5 of this document).

Table 4-11 shows that the preprocess pollution reduction activity that was performed by most facilities was the refusal of items with free liquids. These items are commonly shop towels and printer towels.

This industry has a potential to incorporate preprocess and in-process reduction practices such as the activities presented in Tables 4-11 and 4-12. In addition, industrial laundries have an opportunity to recycle/reuse water and conserve energy, helping to conserve natural resources and reduce the need for end-of-pipe treatment or disposal. However, the pollution reduction activities are so varied that identifying one set of BMPs to apply to all facilities is not practical.

Table 4-9

Types of Laundry Processing Equipment Reported in the Detailed Questionnaire

Type of Equipment[1]	Estimated Number of Facilities Reporting Equipment[2]	Estimated Percentage of Total Facilities Reporting Equipment
Washer-Extractors (D02)	1,668	95.5
Separate Washers (D01)	737	42.2
Separate Extractors (D03)	740	42.4
Dry-Cleaning Units (D04)	252	14.4
Tunnel Washers (D05)	39	2.23
Continuous Roll Towel (CRT) Washers (D07)	35	2.00
Closed-Loop Oil Washers (D08)	34	1.95
Other (Unspecified) (D06)	8	<1
Dip Tanks (D10)	6	<1
Mat/Rug Washers (D09)	0	0

[1]The codes in parentheses are from the detailed questionnaire and were used in the questionnaire database.
[2]Percentages and number of facilities reported are estimated based on the 193 in-scope facilities, extrapolated using appropriate survey weights to represent 1,747 facilities.
Source: 1994 Industrial Laundries Industry Questionnaire.

Table 4-10

Age of Laundry Processing Equipment Reported in the Detailed Questionnaire (Percentage of Equipment Type Installed in Each Time Period)

Time Period	Estimated Number of Units Installed										
	Washers	Washer-Extractors	Extractors	Dry-Cleaning Units	Tunnel Washers	CRT Washers	Closed-Loop Oil Washers	Mat/Rug Washers	Dip Tanks	Other (Unspecified)	Total
Before 1960	43 (1.3%)	0	22 (1.2%)	0	0	0	0	0	0	0	65 (<1%)
1960-1969	529 (15.4%)	114 (1.3%)	193 (10.7%)	18 (3.2%)	0	4 (10.8%)	11 (32.4%)	0	0	0	869 (6.0%)
1970-1979	1,323 (38.6%)	1,452 (16.9%)	341 (18.9%)	63 (11.3%)	0	14 (37.8%)	1 (2.9%)	0	0	8 (100%)	3,202 (22%)
1980-1989	924 (26.9%)	3,763 (43.7%)	857 (47.6%)	253 (45.4%)	28 (45.2%)	17 (45.9%)	22 (64.7%)	0	0	0	5,864 (40.3%)
1990-1995	524 (15.3%)	2,930 (34%)	347 (19.3%)	219 (39.3%)	34 (54.8%)	2 (5.4%)	0	0	0	0	4,056 (27.9%)
Not Specified	86 (2.5%)	357 (4.1%)	42 (2.3%)	4 (<1%)	0	0	0	0	6 (100%)	0	495 (3.4%)
Total[1]	3,429	8,616	1,802	557	62	37	34	0	6	8	14,551

[1]Totals may not equal 100 percent due to rounding.
Source: 1994 Industrial Laundries Industry Questionnaire.

Table 4-11

Preprocess Pollution Reduction Activities

Activity	Estimated Number of Facilities Performing Activity	Estimated Percentage of Total Number of Facilities Reporting Pre-Laundering Activities[1]
Items with Free Liquids Refused	447	26
Certain Items Refused	273	16
Miscellaneous Activities[2]	26	1
Items Centrifuged to Remove Liquids	6	<1
Items Sent to Another Site with Wastewater Treatment	67	4
Steam/Air Stripping of Volatile Organics from Items	2	<1
Items Dry-Cleaned Before Water Washing	24	1
Items Presorted to Remove Objects	32	2

[1]Percentages are estimated based on the 193 in-scope facilities extrapolated using appropriate survey weights to represent the entire industry.
[2]Miscellaneous activities include a combination of the specific activities listed in the table.
Source: 1994 Industrial Laundries Industry Questionnaire.

Table 4-12

In-Process Pollution Reduction Activities

Activity	Estimated Number of Facilities Performing Activity	Estimated Percentage of Total Number of Facilities Reporting In-Process Activities[1]
Change in Laundering/Dry-Cleaning Chemicals Used[2]	132	8
Liquid Injection System for Wash Chemical Addition[2]	109	6
Wastewater Treatment	79	4
Improved Housekeeping[2]	49	3
Improved Training of Employees[2]	149	8
Water Softening[2]	46	3
Equipment Modifications/Installations	43	2
Removal of Lint Before Air Venting to Atmosphere	26	1
Miscellaneous Activities[3]	25	1
Reduced Fuel Consumption	6	<1
Recycling of Laundry Materials	3	<1

[1]Percentages are estimated based on the 193 in-scope facilities extrapolated using appropriate survey weights to represent the entire industry.
[2]Data for these specific in-process pollution reduction activities were specifically requested in the detailed questionnaire.
[3]Miscellaneous activities include a combination of the specific activities listed in this table.

Source: 1994 Industrial Laundries Industry Questionnaire.

The detailed questionnaire requested data for five specific in-process pollution reduction activities. Facilities were requested to report any additional in-process pollution reduction activities; these activities were labeled as "other." Based on descriptions provided by the facilities, supplemental pollution prevention categories were then created for these "other" activities. Table 4-12 presents data for the five activities specified in the questionnaire, as well as for the remaining seven activities. According to responses to the detailed questionnaire, the facilities reporting pollution prevention activities are equally distributed through all production category sizes.

4.6 Trends in the Industry

Several business and operating trends are emerging in the industrial laundries industry, including changes in industrial laundry processes, facility size, and pollution reduction technologies. These trends are discussed in greater detail below.

4.6.1 Trend Away from Dry Cleaning

Based on information supplied by the industry and gathered by EPA on site visits, EPA has determined that many facilities are moving away from dry-cleaning because of the hazardous nature of the dry cleaning solvents and the expense of their disposal. Nineteen percent of the facilities responding to the detailed questionnaire reported owning dry-cleaning units. In addition, the largest percentage (45 percent) of dry-cleaning units was purchased in the 1980s; only 39 percent of all dry-cleaning units in operation today were purchased between 1990 and 1995, as shown in Table 4-10. The facilities that do operate dry cleaning units have moved away from perchlorethylene as a solvent and are now using petroleum-based solvents.

4.6.2 Trend of Small Facilities being Purchased by Larger Firms

In the past several years, there has been a trend toward large firms purchasing smaller firms. Larger firms realize an economy of scale in their operations and can often offer lower prices than smaller companies. Many smaller single-owner companies are finding it difficult to compete with the larger multi-facility firms due to the rising costs of both washroom and treatment equipment, the difficulty in raising capital, the utilization of new technologies, and the requirement of more professional management (2). Because of this increased difficulty to compete, these smaller facilities are being purchased by the larger firms.

There are many reasons that the larger firms are purchasing smaller facilities. One of the benefits of a large firm is that they have the capability to offer many specialized laundering services, (e.g., laundering of clean room items). In essence, the larger firms are more diversified and thus have the capability to process laundry and treat the wastewater generated from a variety of customers. A 1997 analysis showed that the largest five firms controlled about 55 percent of the market (2).

4.6.3 Trends in Equipment and Technologies

The industry as a whole is moving towards automation in the washing, drying, folding, and packaging of items laundered. This includes practices ranging from installing automatic detergent dispensers in the washers to purchasing washer-extractors instead of separate washers and extractors. Another trend is the installation of tunnel washers; these washers have a built-in "reuse cycle" where the final rinse water is automatically cycled back to the first rinse. The use of these washers lowers the average water used per pound of item laundered and thus saves the facilities money.

The preprocess pollution prevention activities reported by facilities responding to the detailed questionnaire were initiated primarily in the late 1980s to 1994. The trend within the industry appears to be to continue and increase pollution prevention activities. Some of these pollution prevention activities include the installation of more efficient washers and extractors, detergents that allow for lower wash temperatures and a lower pH for the removal of oils and grease from the items which may result in lower residual solids volume and less energy use. Chapter 6 of this document discusses pollution prevention practices in more detail.

4.7 Treatment Technologies in Use

The principal types of wastewater treatment reported by industrial laundries in the detailed questionnaire include gravity settling, screens, equalization/neutralization, air flotation, clarification, and oil/water separation. Chapter 6 of this document discusses wastewater treatment technologies used by the industry in greater detail.

4.8 Industry Definition

One of the steps in developing the proposed pretreatment standards and the final action for the industrial laundries industry was to define the scope of the industry. EPA reviewed data collected from responses to the detailed questionnaires, during site and sampling visits to industrial laundries, and in previous Agency efforts to regulate this industry to define the scope of the industry.

Initially, EPA reviewed laundry processes and associated water use and wastewater discharge practices to determine if facilities that used and/or discharged little or no water could be eliminated from the scope of the industry. Processes generating minimal or no wastewater would have little to no pollutants being discharged into the wastewater stream requiring control. Based on the data collected by EPA, 97 percent of all laundering performed by industrial laundries is water washing. As discussed in this Chapter and Chapter 5, industrial laundry treated by oil-only dust control mop treatment generates no wastewater. Therefore, EPA excluded oil-only dust control mop treatment from the scope of the industry. Industrial laundry treated by dry cleaning generates little wastewater (ranging from zero gallons per pound of laundry processed to 0.25 gallons per pound of laundry processed). Because this process generates an insignificant amount of wastewater, EPA excluded it from the scope of the industry. Only water-washing laundering processes are included in the scope of the industry. In addition, one facility reported dyeing of new items. EPA does not consider dyeing of new items to be a

laundering process; therefore, it is also excluded from the scope of the industry. Dyeing of used textile items such as shop and printer towels/rags, which is often performed as part of the washing process, is included in the scope of the industry.

EPA looked at the types of items that were water-washed to determine if any specific items should be excluded from the scope. EPA performed a statistical comparison of raw wastewater from facilities laundering primarily linen items and raw wastewater from facilities laundering primarily industrial laundry items. EPA also performed a statistical comparison of raw wastewater from facilities laundering primarily linen items and raw wastewater from facilities performing denim prewashing. A summary of the statistical comparison is presented below and a detailed discussion is presented in the Statistical Support Document (1).

Data from EPA's sampling program and the detailed monitoring questionnaire (DMQ) were used in comparing raw linen wastewater to raw industrial laundry wastewater. EPA used data from facilities processing between 60 and 99 percent linen items to represent raw linen wastewater; EPA did not have data available for facilities processing 100 percent linen items. EPA first performed a statistical analysis of the linen wastewater data and a statistical analysis of the industrial laundry wastewater data to determine whether the data were statistically different. If data for a pollutant were determined to be significantly different among the linen wastewater data or among the industrial laundry wastewater data, that pollutant was not included in the comparison. Based on this analysis, a comparison of linen wastewater data and industrial laundry wastewater data could be performed for eight pollutants. These pollutants and the results of the comparison are shown in Table 4-13. Table 4-13 shows that industrial laundry raw wastewater concentrations are significantly different from linen raw wastewater concentrations for all eight pollutants. Also, the industrial laundry wastewater mean concentration is consistently at a significantly higher value than the linen wastewater mean concentration for all eight pollutants. Although the linen facilities were processing less than 100 percent linen, EPA assumes that the results of the statistical comparison would be valid if these facilities were processing 100 percent linen items.

Data from EPA's sampling program, the DMQ, and data obtained from a site visit were used in comparing raw linen wastewater to raw denim prewash wastewater. Raw denim prewash wastewater data were available for only one facility. EPA performed a statistical analysis of the linen wastewater data to determine whether the data were statistically different. Based on this analysis, a comparison of linen wastewater data and denim prewash wastewater data could be performed for seven pollutants. These pollutants and the results of the comparison are shown on Table 4-14. Table 4-14 shows that raw linen wastewater concentrations are significantly higher than raw denim prewash wastewater concentrations for cadmium, chromium, and copper, but the concentrations are similar for the other five pollutants.

Based on the results of the statistical analyses and the relatively low pollutant concentrations found in linen and denim prewash wastewater, EPA decided to exclude linen and denim prewash items from the scope of the industrial laundries industry.

Table 4-13

Comparison of Linen Facility and Industrial Laundry Facility Mean Pollutant Log Concentrations

Analyte	Type of Facility	Sample Size	Mean log Concentration	Mean Concentration (mg/L)	P-value	Significant at a=0.01?
TPH (as SGT-HEM)	Industrial Laundry	30	6.05	425	0.0001	Yes
	Linen	5	2.64	14		
Oil and Grease (as HEM)	Industrial Laundry	8	7.18	1310	0.0012	Yes
	Linen	8	4.56	96		
Total Suspended Solids	Industrial Laundry	34	7.10	1206	<0.0001	Yes
	Linen	9	5.08	161		
Cadmium	Industrial Laundry	34	-2.66	.070	0.0001	Yes
	Linen	15	-4.33	.013		
Chromium	Industrial Laundry	34	-1.47	.230	<0.0001	Yes
	Linen	15	-3.19	.041		
Copper	Industrial Laundry	34	0.85	2.32	<0.0001	Yes
	Linen	15	-1.54	.21		
Iron	Industrial Laundry	34	3.23	25.2	<0.0001	Yes
	Linen	5	1.00	2.71		
Zinc	Industrial Laundry	34	1.47	4.16	<0.0001	Yes
	Linen	17	1.15	0.32		

Source: U.S. Environmental Protection Agency, Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category, EPA 821-R-97-006, Washington, DC, November 1997.

Table 4-14

Comparison of Linen Facility and Denim Prewash Facility Mean Pollutant Log Concentrations

Analyte	Type of Facility	Sample Size	Mean log (Conc)	Mean Concentration (mg/L)	p-value	Significant at a=0.01?
Oil and Grease (as HEM)	Linen	8	4.56	95	0.018	No
	Denim Prewash	7	2.96	19		
Total Suspended Solids	Linen	9	5.08	161	0.021	No
	Denim Prewash	15	6.15	470		
Cadmium	Linen	15	-4.33	0.013	0.0001	Yes
	Denim Prewash	13	-5.68	0.003		
Chromium	Linen	15	-3.19	0.04	0.0014	Yes
	Denim Prewash	13	-4.47	0.01		
Copper	Linen	15	-1.54	0.21	0.001	Yes
	Denim Prewash	13	-2.85	0.06		
Iron	Linen	5	1.00	2.71	0.027	No
	Denim Prewash	12	-0.69	0.50		
Zinc	Linen	17	-1.15	0.32	0.114	No
	Denim Prewash	8	-2.87	0.06		

Source: U.S. Environmental Protection Agency, Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category, EPA 821-R-97-006, Washington, DC, November 1997.

As part of comments on the proposed rule, EPA received data including wastewater monitoring data on clean room items. The term "clean room items" refers to specialty items used in particle- and static-free environments by computer manufacturing, pharmaceutical, biotechnology, aerospace, and other industrial customers. EPA evaluated the data and determined that the concentrations of pollutants found in clean room item wastewater were lower than the concentrations found in wastewater from most other items defined as industrial laundry items in the proposed rule, and the characteristics of the clean room wastewater were similar to linen wastewater. Thus, the data support the removal of clean room items from the definition of industrial textile items, which excludes laundering of clean room items from the scope of the industry. The clean room data are presented in Section 17 of the Industrial Laundries Administrative Record.

EPA also excluded on-site laundries from the applicability of the rule. The focus of the rulemaking effort was industrial laundries that function independently of other industrial activities that generate wastewater. EPA believes it is more appropriate to address on-site laundry discharges at industrial facilities as part of the effluent controls from the facility as a whole, for several reasons. First, many such facilities commingle laundry wastewater with wastewater from other processes. Second, EPA anticipates that contaminants removed from laundered items can best be treated with process wastewater containing similar contaminants. EPA has already established categorical effluent guidelines and standards for 51 industries, as listed in Appendix B of this document. These regulations generally apply to process-contaminated wastewaters generated from the facility operations, including on-site laundering. For example, the OCPSF effluent guidelines control discharges from garment laundering at OCPSF facilities. For industries not yet covered by effluent limitations guidelines and standards, EPA will examine these industries and their wastewater treatment processes in the context of the entire industrial facility, not just the laundering portion of the facility. Addressing on-site laundering discharges along with other industrial discharges in an industry allows EPA to examine all of the production and processing equipment used by the industry, all of the discharges in an industry, all the potential wastewater treatment applicable to the industry, and all of the economic impacts of any such national regulation for the industrial category (or subcategory) as a whole.

Based on these analyses, EPA developed the following definition of industrial laundries:

> An *industrial laundry* is any facility that launders industrial textile items from off site as a business activity (i.e., launders industrial textile items for other business entities for a fee or through a cooperative agreement). Either the industrial laundry or the off-site customer may own the industrial textile items. This definition includes textile rental companies that perform laundering operations. *Laundering* in this definition means washing with water, including water washing following dry cleaning. Laundering exclusively through dry cleaning and oil cleaning of mops in a process that does not use any water are not included in this definition of laundering, even if these operations are conducted by an industrial laundry. *Industrial textile* items include, but are not limited to: industrial shop towels, printer towels/rags, furniture towels, rags, uniforms, mops, mats, rugs,

tool covers, fender covers, dust-control items, gloves, buffing pads, absorbents, and filters. If any of these items are used at hotels, hospitals, or restaurants, they are not considered industrial items.

A facility that performs any laundering of industrial textile items is classified as an industrial laundry, even if the facility also performs activities that are not defined as industrial laundering. EPA does not include the following within the scope of the industrial laundries industry: on-site laundering at industrial facilities (e.g., a chemical manufacturer that washes employee uniforms on site), laundering of industrial textile items originating from the same business entity (e.g., a chain of auto repair shops that operates a central laundry for items from individual shops), and exclusively laundering linen items, clean room items, denim prewash items, new items (i.e., items directly from the textile manufacturer, not yet used for their intended purpose), hospital, hotel, and restaurant items or any combination of these items. However, EPA does consider hotels, hospitals, or restaurants to be within the scope of the industrial laundries industry if they launder industrial textile items originating from industrial facilities. Linen items are sheets, pillow cases, blankets, bath towels and washcloths, hospital gowns and robes, tablecloths, napkins, tableskirts, kitchen textile items, continuous roll towels, laboratory coats, household laundry (such as clothes, but not industrial uniforms), executive wear, mattress pads, incontinence pads, and diapers. EPA intends this to be an all-inclusive list of linen items.

4.9 References

1. U.S. Environmental Protection Agency. Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category. EPA-821-R-97-006, Washington, DC, November 1997.

2. K. Koepper. “Don’t Count Out More Public Company Acquisitions.” Industrial Launderer. August 1997: page 24.

CHAPTER 5

WATER USE, WASTEWATER CHARACTERIZATION, AND POLLUTANTS OF CONCERN

5.1 Introduction

This chapter discusses water use practices for the industrial laundries industry and presents raw wastewater characterization data for item-specific and total wastewater streams at industrial laundries. This chapter also presents pollutants analyzed and pollutants of concern for the industrial laundries industry. The water use data presented in this chapter are from 193 facilities responding to the 1994 Industrial Laundries Industry Questionnaire (detailed questionnaire) that were considered in scope for the proposed rule. These facilities include three clean room facilities that are out of scope for the final action (the industry definition is presented in Chapter 4 of this document). Where appropriate, these data have been extrapolated using statistically-derived survey weights to represent the entire industry. The wastewater characterization data presented in this chapter are from EPA sampling episodes and facility self monitoring data from the Detailed Monitoring Questionnaire (DMQ).

The remainder of this chapter is presented as follows:

- Section 5.2 discusses the sources of industrial laundry service water and the uses of service water within the industry;
- Section 5.3 discusses wastewater volume by type of discharge;
- Section 5.4 discusses water conservation measures implemented by some industrial laundries;
- Section 5.5 discusses the pollutants analyzed in industrial laundry wastewater;
- Section 5.6 identifies the pollutants of concern for the industrial laundries industry;
- Section 5.7 discusses characterization of raw wastewater by item laundered;
- Section 5.8 discusses characterization of total, heavy, and light raw wastewater streams; and
- Section 5.9 presents the characterization of EPA Method 1664 constituents.
- Section 5.10 presents the references used in this chapter.

5.2 Sources of Service Water and Water Use

This section provides information on sources of service water and water use breakdown as reported by industrial laundries responding to the detailed questionnaire.

5.2.1 Sources of Service Water at Industrial Laundries

Service water in the industrial laundries industry refers to any water used at a facility, ranging from sanitary water to laundry process water. The primary source of service water at industrial laundries is a water authority or municipal source. Well water is also used as service water at some facilities. None of the industrial laundries that responded to the detailed questionnaire reported surface water as the direct intake source of their service water. Table 5-1 presents the sources of service water for the industrial laundries industry; these data have been extrapolated to represent the entire industry.

5.2.2 Use of Service Water at Industrial Laundries

Industrial laundries use service water for a variety of purposes. Table 5-2 presents the various uses of service water, the number of facilities reporting each use, and the percentage of the total industry service water represented by each use. These amounts are based on the first use of the service water. Water recycle/reuse is not included in Table 5-2. Table 5-2 is based on available data from the detailed questionnaire extrapolated to represent the entire industrial laundries industry.

Laundry Process Water Use

The majority of service water is used for laundry processes. As discussed in Chapter 4 of this document, the laundering processes that use water and generate wastewater include:

- Water washing;
- Dual-phase washing; and
- Dust control mop treatment (water washing of mops followed by oil treatment).

Facilities use varying amounts of laundry process water per pound of laundry processed due to the following factors:

- Type of items laundered;
- Customers;
- Soil loading on items;
- Laundering chemicals used in wash formulas; and
- Laundry processing equipment used.

Table 5-1

Service Water Sources

Service Water Source	Estimated Number of Facilities By Source[1]	Estimated Percentage of Total Facilities By Source
Water Authority/Municipal Source Only	1,572	90
Private Well Only	1	< 1
Water Authority/Municipal Source and Private Well	174	10
Surface Water (Directly)	0	0
Total	**1,747**	**100**

[1]Based on responses to the detailed questionnaire from the 193 facilities that were in scope for the proposed rule (including three clean room facilities determined to be out of scope for the final action), extrapolated to represent the entire industrial laundries industry.
Source: 1994 Industrial Laundries Industry Questionnaire.

Table 5-2

Service Water Use

Service Water Use	Estimated Number of Facilities By Use[1]	Estimated Percentage of Total Service Water By Use
Laundry Process Water	1,745	92.1
Sanitary Water	1,670	3.1
Floor/Equipment Washing	956	<1
Boiler Water	599	1.8
Vehicle Washing	584	<1
Noncontact Cooling Water	490	1.4
Water Softener Regeneration Water	94	<1
Other Uses Not Reported	72	<1
Wastewater Treatment	37	<1
Air Conditioning	26	<1
Landscaping	25	<1
Dish Washing	22	<1
Irrigation	1	<1
Total	-	**100**

[1]Number of facilities reporting water use is based on the responses to the detailed questionnaire from 193 facilities that were in scope for the proposed rule (including three clean room facilities determined to be out of scope for the final action), extrapolated to represent the entire industrial laundries industry. The number of facilities reporting each service water use is based on the first use of the service water; recycle/reuse is not included in Table 5-2. One facility reported using service water first as noncontact cooling water, then as process water. This facility has a survey weight of 2.

Source: 1994 Industrial Laundries Industry Questionnaire.

The amount of process water used at a facility is most directly related to the quantity of items laundered. Figure 5-1 shows the distribution of facilities by amount of laundry process water used per pound of laundry processed. Water used in laundry processing comprises the service water that is allocated to laundry processing, the process water that is reused before and/or after wastewater treatment, and the water from other processes that is reused as laundry process water (e.g., noncontact cooling water). This water use was normalized to account for all laundry production from processes that generate wastewater. The average amount of wastewater discharged per pound of laundry processed is 2.74 gallons per pound. Over 86 percent of the industry uses between 1 and 4 gallons of process water per pound of laundry that is water-washed.

Water use is also related to type of item laundered. An analysis of item-specific water use per pound of laundry processed (gal/lb) was conducted using data from facility responses to the detailed questionnaire. Table 5-3 presents the item-specific water use in gallons of water per pound of laundry (gal/lb) by process. These amounts were calculated from information provided in the wash formulas reported by facilities in the detailed questionnaire. For most items, EPA calculated a median water use ranging from 2.40 to 3.30 gal/lb. Denim prewashing of new items requires the highest use of water with a median value of 5.40 gal/lb. Water washing of buffing pads requires the least amount of water (0.50 gal/lb), but this amount is based on information from only one facility.

Other Industrial Laundry Water Uses

Although most of the incoming service water used at industrial laundries (92.1 percent) is used as laundry process water, there are a number of other service water uses, as presented in Table 5-2. After laundry process water, sanitary water accounts for the second largest amount (3.1 percent) of total service water used at industrial laundries. Boiler water accounts for the third most significant use of service water (1.8 percent), followed by noncontact cooling water (1.4 percent). Noncontact cooling water includes water used in evaporative coolers and other heat exchangers. Approximately 95 percent of the facilities that reported noncontact cooling water use recycle their noncontact cooling water. In many instances, the recycled water is used as laundry process water. Other uses of service water at industrial laundries include vehicle washing, floor/equipment washing, and water used in wastewater treatment systems. These uses each represent less than one percent of the total service water used at industrial laundry facilities.

5.3 Wastewater Volume by Type of Discharge

All of the 193 facilities responding to the detailed questionnaire were considered in scope for the proposed rule. None of the facilities reported discharging laundry process wastewater or noncontact cooling water directly to surface water. Residual wastewater found in the sludge and oil wastes generated during wastewater pretreatment is also not discharged directly, but disposed of off site or land applied. Table 5-4 presents process wastewater discharge practices reported by the facilities that responded to the detailed questionnaire.

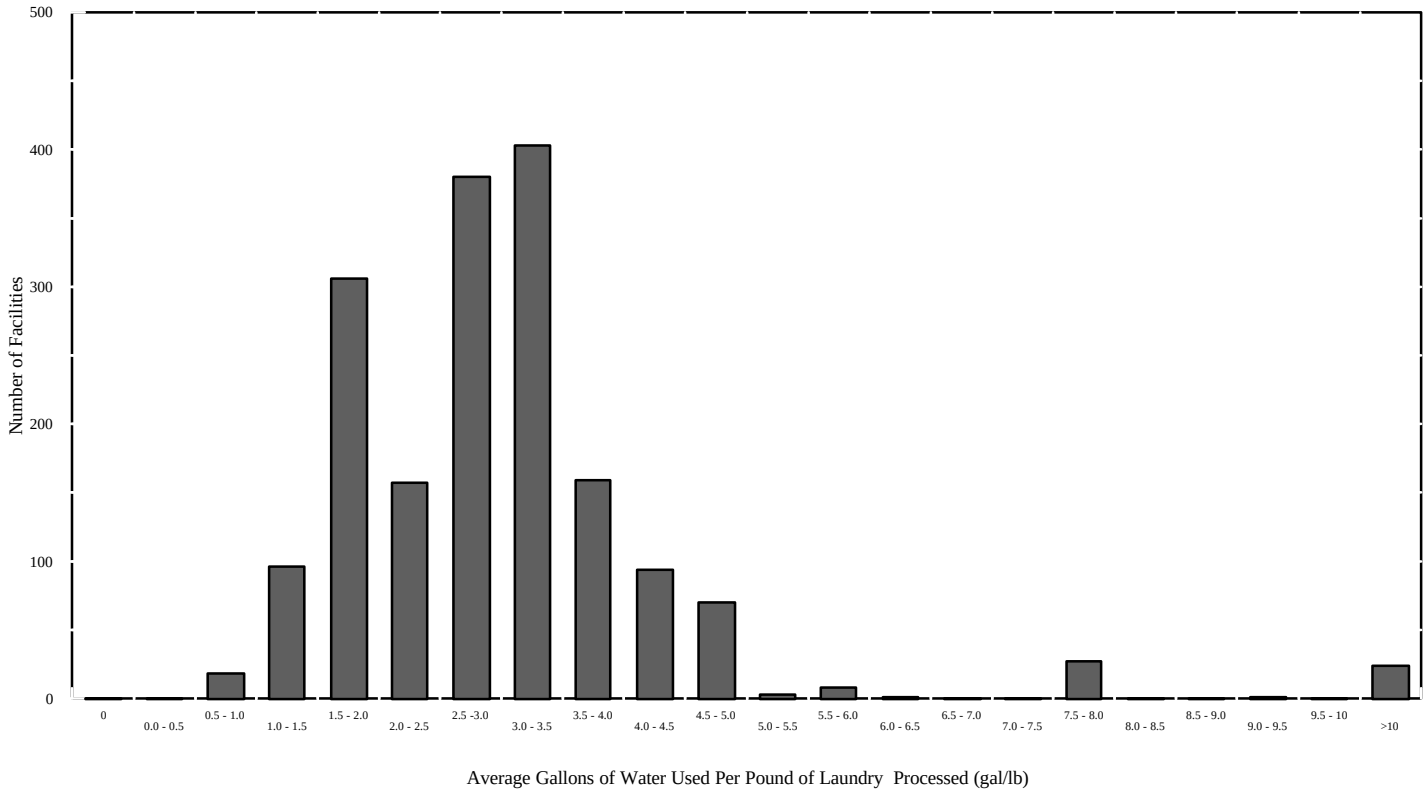

Figure 5-1. Distribution of Facilities by Production-Normalized Laundry Process Water Use[1]

[1]Based on responses to the detailed questionnaire from the 193 facilities that were in scope for the proposed rule (including three clean room facilities determined to be out of scope for the final action), extrapolated to represent the entire industrial laundries industry.

Table 5-3

Item-Specific Water Use[1]

Item[2]	Process[3]	Mean (gal/lb)	Median (gal/lb)	Standard Deviation (gal/lb)	Estimated Number of Facilities in Calculations
Industrial Garments (B01)	A01	2.66	2.40	1.47	148
	A02	3.73	2.80	2.46	3
Shop Towels (B02)	A01	4.18	3.10	8.73	126
Printer Towels (B03)	A01	4.12	3.60	2.32	65
	A02	3.70	3.80	0.29	3
Floor Mats (B04)	A01	1.87	1.60	0.98	163
	A02	2.10	2.10	---	1
Mops, Dust Cloths, Tool Covers, etc. (B05)	A01	3.00	2.80	1.57	83
	A07	3.03	2.90	1.58	45
Linen Supply Garments (B06)	A01	3.51	3.30	1.62	99
Linen Flatwork/Full Dry (B07)	A01	3.03	2.80	1.34	121
Health-Care Items (B08)	A01	2.53	2.40	1.02	67
Fender Covers (B09)	A01	3.55	2.70	3.65	65
Continuous Roll Towels (B10)	A01	2.88	2.40	4.32	79
Clean Room Garments (B11)	A01	2.93	3.00	0.52	9
Other (B13)	A01	4.00	4.00	---	1
Laundry Bags (B14)	A01	1.45	1.45	0.45	2
Family Laundry (B15)	A01	3.35	3.05	1.28	6

Table 5-3 (Continued)

Item[2]	Process[3]	Mean (gal/lb)	Median (gal/lb)	Standard Deviation (gal/lb)	Estimated Number of Facilities in Calculations
New Items (B17)	A01	3.00	2.75	1.17	6
	A13	5.63	5.40	1.76	3
Executive Wear (B18)	A01	4.74	2.90	4.67	5
Miscellaneous NOG (Not Our Goods) (B19)	A01	3.00	3.00	---	1
Rewashed Items (B20)	A01	2.18	2.10	0.77	5
Filters (B23)	A01	4.20	4.20	1.20	2
Buffing Pads (B24)	A01	0.50	0.50	---	1

[1] The process/item gallon-per-pound ratios were calculated from water-washing formula data provided in Table C of the detailed questionnaire. This analysis was performed using data from 193 facilities that were in scope for the proposed rule (including three clean room facilities determined to be out of scope for the final action); the data were not extrapolated to represent the entire industry. The ratios for each formula at a facility were calculated and the ratios were averaged for each item/process combination at individual facilities. The number of times the formula was used per day was taken into account. The facility-specific ratios were then used to calculate an industry mean and median gallon/pound ratio for each item/process combination. There were no usable data to calculate the water use requirements for absorbents, clean wipes, or airline carpet and seat covers.

[2] The codes in parentheses reflect the item codes used in the detailed questionnaire.

[3] Process codes used in the detailed questionnaire:

A01 - Water Washing
A02 - Dual Phase Washing: Petroleum solvent wash followed by water washing
A07 - Dust Control Mop Treatment: Water washing followed by oil treatment
A13 - Denim Prewash.

Source: 1994 Industrial Laundries Industry Questionnaire.

Table 5-4

Discharge Practices of Industrial Laundries[1]

Discharge Practice	Estimated Number of Facilities Discharging Laundry Process Wastewater (Percent of Facilities)	Estimated Number of Facilities Discharging Noncontact Cooling Water (Percent of Facilities)
Discharge to POTW	1,747 (100%)	313 (18%)
Off-Site Disposal	221 (13%)	0 (0%)
Land Application	84 (5%)	0 (0%)
Discharge to Surface Water	0 (0%)	0 (0%)

[1]Based on responses to the detailed questionnaire from 193 facilities that were in scope for the proposed rule (including three clean room facilities that were determined to be out of scope for the final action), extrapolated to represent the entire industrial laundries industry.
Source: 1994 Industrial Laundries Industry Questionnaire

Figure 5-2 shows the distribution of facilities by amount of laundry process wastewater discharged per pound of laundry processed. The total wastewater discharged comprises the laundry process wastewater that is discharged to a POTW, the laundry process wastewater that is land applied, and the laundry process wastewater that is shipped off site for disposal. This calculated wastewater discharge was normalized for all laundry production from processes that generate wastewater. Over 60 percent of the facilities discharge between 1.5 and 3.5 gallons of process wastewater per pound of laundry that is water-washed.

A comparison of the values in Figures 5-1 and 5-2 shows that more laundry process water is used than is discharged. This difference is due to evaporation losses and laundry process wastewater recycle/reuse before and after wastewater treatment. (The average evaporation loss reported by facilities in the detailed questionnaire was approximately 10 percent. For 81 percent of the facilities, the difference between laundry process water use and discharge is less than 0.5 gal/lb. Most of the reported amounts of laundry process wastewater discharged are estimates; less than 15 percent of the facilities measure the amount of wastewater that is discharged at their facilities.

5.4 Water Conservation Measures

Approximately 85 percent of the facilities that responded to the detailed questionnaire reported performing some type of water conservation practice. Table 5-5 presents activities that were reported as standard water conservation techniques at industrial laundries. Table 5-5 also presents the reported water use reduction due to implementation of these conservation practices. As shown in the table, prompt attention to faulty equipment, leaks, and other problems is practiced by the greatest number of laundries, followed by routine monitoring of water use. Chapter 6 provides additional information on wastewater recycle/reuse.

5.5 Pollutants Analyzed in Industrial Laundry Wastewater

EPA collected data to determine the conventional, priority, and nonconventional pollutants to be regulated for the industrial laundries proposed rule. Conventional pollutant parameters are defined in section 304(a)(4) of the Clean Water Act (CWA) and in 40 CFR Part 401.16 and include biochemical oxygen demand (BOD_5), total suspended solids (TSS), total recoverable oil and grease, pH, and fecal coliform. These pollutants are subject to regulation as specified in sections 301(b)(2)(E) and 304(b)(4)(B) of the CWA. Toxic or priority pollutants are defined in section 307(a)(1) of the CWA. The list of priority pollutants, presented in Table C-1 in Appendix C of this document, consists of 126 specific pollutants listed in 40 CFR Part 423, Appendix A. Sections 301(b)(2)(C) and 304(b)(2)(B) of the CWA authorize EPA to regulate priority pollutants. Nonconventional pollutants are those that are neither priority pollutants or conventional pollutants. Sections 301(b)(2)(F), 301(g), and 304(b)(2)(B) of the CWA give EPA the authority to regulate nonconventional pollutants.

EPA considered four conventional, 98 priority, and 213 nonconventional organic, metal, and elemental pollutant parameters for potential control for the industrial laundries industry. Three hundred twelve (312) of these pollutants are listed in The Industrial

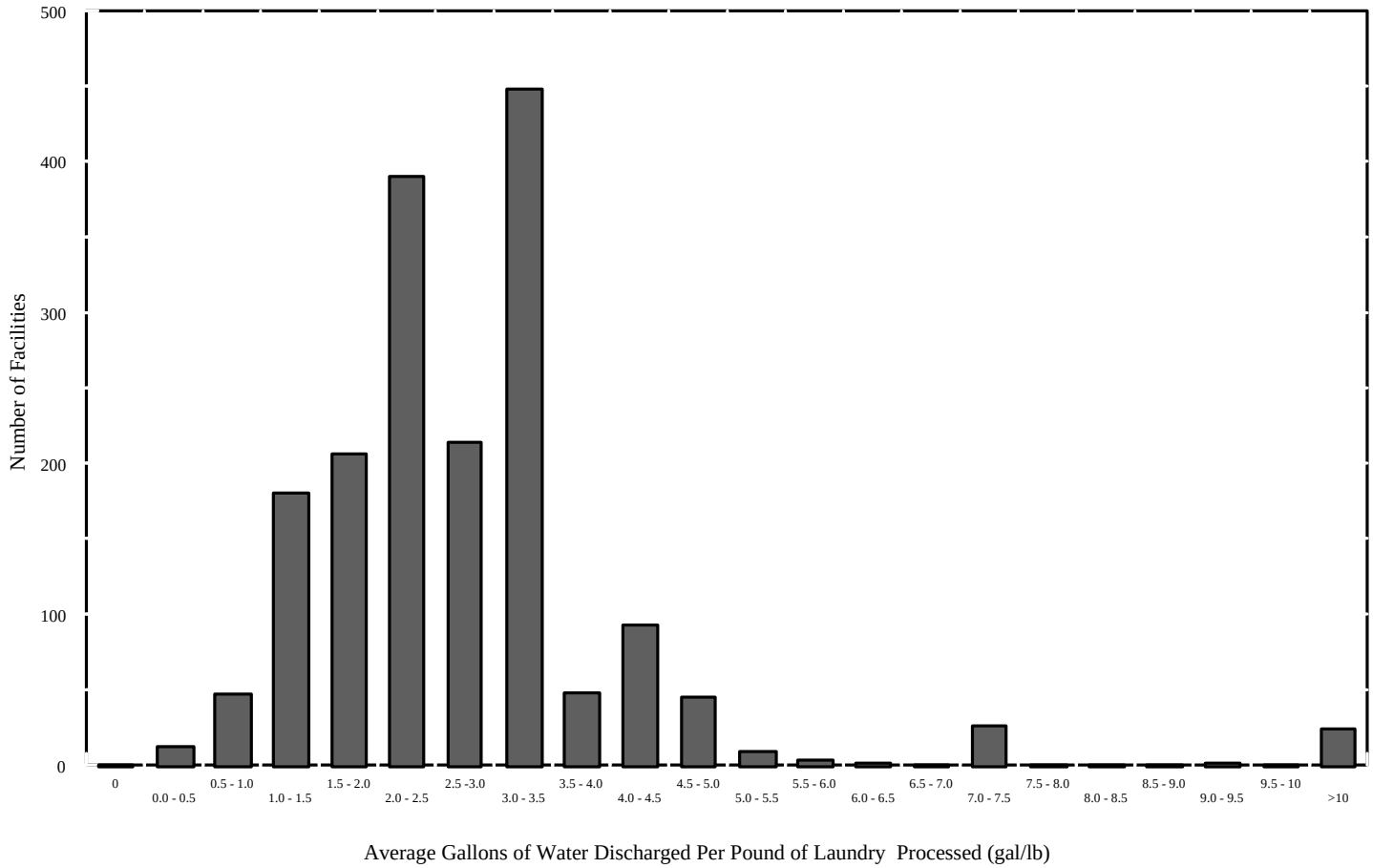

Figure 5-2. Distribution of Facilities by Production-Normalized Laundry Process Wastewater Discharge[1]

[1]Based on responses to the detailed questionnaire from the 193 facilities that were in scope for the proposed rule (including three clean room facilities determined to be out of scope for the final action), extrapolated to represent the entire industrial laundries industry.

Table 5-5

Water Conservation Practices and Water Use Reduction

Water Conservation Practice	Water Reduction Range (gal/day)	Estimated Number of Facilities With This Practice[1]	Percentage of Total Facilities With This Practice[1]
Prompt Attention to Faulty Equipment, Leaks, and Other Problems	0 - 25,000	1,180	68%
Routine Monitoring of Water Use	0 - 57,693	996	57%
Installation of Laundering Equipment That Uses Less Water	16 - 165,000	266	15%
Implementation of Alternative Laundry Wash Formulas That Require Less Water	6 - 26,000	261	15%
Reuse of Noncontact Cooling Water as Process Makeup Water	150 - 31,623	246	14%
Recycling/Reuse of Laundry Wastewater Before Treatment	60 - 53,000	155	9%
Implementation of Alternative Production Processes That Require Less Water	82 - 20,000	44	2%
Other Practices	200 - 6,000	19	1%
Installation of Automatic Monitoring and Alarm Systems on In-plant Discharges	500 - 7,985	17	1%
Recycle/Reuse of Laundry Wastewater After Treatment	3,000 - 29,000	13	1%
Reuse of Nonlaundry Wastewater as Laundry Process Water	8,967	4	<1%

[1]Based on responses to the detailed questionnaire from 193 facilities that were in scope for the proposed rule, extrapolated to represent entire industry.

Source: 1994 Industrial Laundries Industry Questionnaire.

Technology Division List of Analytes, which was derived from the List of Lists (1). Three pollutants not on this list were also considered for regulation. EPA analyzed industrial laundry wastewater for these 315 pollutants during the industrial laundries sampling program, which is discussed in Chapter 3 of this document. Table C-2 in Appendix C lists the 315 pollutants analyzed by EPA in industrial laundry wastewater during this sampling program. EPA used data collected from seven industrial laundries during the period of 1993-1996 for selecting pollutants of concern.

EPA used EPA Method 1664 to analyze oil and grease and total petroleum hydrocarbons because the other approved methods (EPA Methods 413.1, 413.2, and 415.1) use freon, which is being phased out of use in EPA's CWA and RCRA programs. Method 1664 measures oil and grease as hexane extractable material (HEM) and measures TPH as silica gel treated hexane extractable material (SGT-HEM)[2].

Several conventional and priority pollutants were not considered for regulation for the industrial laundries industry based on the following: information collected during the 1985-1987 industrial laundries sampling program, described in Chapter 3; information collected from the Detailed Monitoring Questionnaire (DMQ), described in Chapter 3; and EPA's knowledge of industrial laundry wastewater. The DMQ was sent to 37 facilities selected from respondents to the 1994 Industrial Laundries Industry Questionnaire. The DMQ recipients submitted monitoring data collected at their facility during 1993.

EPA did not consider the following conventional and priority pollutants for regulation for the industrial laundries industry:

- Fecal coliform;
- Asbestos;
- 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD);
- Twenty-five (25) pesticides and PCBs (pollutants 89 through 113 on Table C-1 in Appendix C); and
- Cyanide.

EPA does not expect fecal coliform bacteria to be present in industrial laundry wastewaters because the laundering chemicals added to laundry process water and the temperature of the water will likely destroy fecal coliform that may have been present on laundered items.

[2]In Method 1664 (promulgated at 64 FR 263125 on May 14, 1999), EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Record, EPA refers to SGT-HEM as TPH.

EPA does not expect asbestos to be present in industrial laundry wastewaters because it is not expected to be present on items laundered by industrial laundries or generated during the washing process.

EPA does not expect dioxins and furans, including 2,3,7,8-TCDD, to be present on industrial laundry items and EPA does not expect dioxins and furans to be formed during industrial laundry processes. Dioxins and furans were not detected in available industrial laundry wastewater samples collected during three sampling episodes during the 1985-1987 sampling program (dioxins and furans were not analyzed for during the other two episodes). One facility responding to the DMQ questionnaire submitted data for 2,3,7,8-TCDD; this compound was not detected at the facility. A review of POTW permits for 92 industrial laundries indicated that none of the permits includes limits for dioxins and furans.

EPA did not consider PCBs for regulation because PCBs were not detected in available industrial laundry wastewater samples from four sampling episodes during the 1985-1987 sampling program (PCBs were not analyzed for during one other episode). Four facilities responding to the DMQ submitted data for up to seven PCBs; PCBs were not detected at any of the four facilities. A review of publicly owned treatment works (POTW) permits for 92 industrial laundries indicated that only one of the permits includes limits for PCBs.

EPA did not consider any pesticides for regulation because most of the priority pollutant pesticides were detected in less than 10 percent of available industrial laundry wastewater samples and the presence of pesticides in industrial laundry wastewater is a site-specific issue related to a particular customer base. Pesticides are best addressed through case-by-case review of specific circumstances rather than a national regulation. Industrial laundry wastewater was analyzed for pesticides at four facilities during the 1985-1987 sampling program. In addition, 10 DMQ facilities submitted pesticide data. Of the 18 priority pollutant pesticides, the following three pesticides were detected in 10 percent or greater of industrial laundry wastewater samples:

- Heptachlor (10 percent);
- delta-BHC (14 percent); and
- Endosulfan sulfate (14 percent).

Heptachlor was detected at 2 facilities (sampled at 14 facilities), delta-BHC was detected at 2 facilities (sampled at 11 facilities), and endosulfan sulfate was detected at 4 facilities (sampled at 11 facilities). Endosulfan sulfate and dieldrin were the only priority pollutant pesticides detected at concentrations greater than 0.1 mg/L, and detections at these concentrations occurred at only one facility of 11 facilities sampled for each pesticide. Also, review of POTW permits for 92 industrial laundries indicated that only one of the permits includes limits for pesticides.

EPA did not consider cyanide for regulation because cyanide was detected at most facilities at insignificant concentrations. Cyanide was analyzed at five facilities during the 1985-1987 sampling program, and 16 DMQ facilities submitted cyanide data. Only two of these facilities reported detected concentrations of cyanide greater than 1 mg/L and only one of these

facilities had an average detected concentration greater than 1 mg/L. Cyanide was not detected at five facilities, and cyanide was detected at average concentrations of less than 0.1 mg/L at eight facilities. The maximum contaminant level for cyanide, as established in the National Primary Drinking Water Regulations (40 CFR Part 141), is 0.2 mg/L, as free cyanide. Only one DMQ facility reported an average cyanide concentration greater than 0.2 mg/L. This facility did not report the analytical method used. Two facilities from the 1985-1987 sampling program had average cyanide concentrations greater than 0.2 mg/L, but these concentrations were measured as total cyanide.

5.6 Identification of Pollutants of Concern

In assessing the 315 pollutant parameters analyzed during the 1993-1996 industrial laundries sampling program, EPA used the following criteria to identify pollutant parameters of concern. EPA reduced the list of 315 pollutants to 72 pollutants for further consideration using the following criteria:

- Pollutants never detected in any samples collected during seven sampling episodes during the 1993-1996 industrial laundries sampling program. Table 5-6 lists the 175 pollutants meeting this criterion.

- Pollutants detected in less than 10 percent of samples collected during seven sampling episodes during the 1993-1996 industrial laundries sampling program. Table 5-7 lists the 50 pollutants meeting this criterion.

- Pollutants identified during screening, but not quantified due to a lack of an acceptable analytical method. EPA used analytical Method 1620 (ICP) to quantitate certain metals and elemental pollutants. Eight metal and elemental pollutants that were detected in industrial laundry samples greater than 10 percent of the time were not analyzed in a quantitative manner. Analyses for these pollutants were not subject to the quality assurance/quality control (QA/QC) procedures required by analytical Method 1620. These results were used for screening purposes only and the metals and elements detected were excluded from the pollutants of concern because they are not quantified. Table 5-8 lists these metal pollutants.

- Pollutants detected in source water at comparable concentrations to industrial laundry raw wastewater. Three nonconventional metal pollutants (calcium, magnesium, and sodium) were excluded because EPA believes that these pollutants are not present in industrial laundry wastewater at significant levels.

Table 5-6

Pollutants Not Detected in Any Samples Analyzed during the 1993-1996 Industrial Laundries Sampling Program

Pollutant	Class Code	Pollutant	Class Code
Acenaphthene	TXO	Vinyl Chloride	TXO
Acenaphthylene	TXO	1,1,2-Trichloroethane	TXO
Anthracene	TXO	1,2-Dichlorobenzene	TXO
Benzidine	TXO	1,2-Dichloropropane	TXO
Benzo(a)anthracene	TXO	1,2,4-Trichlorobenzene	TXO
Benzo(a)pyrene	TXO	1,3-Dichlorobenzene	TXO
Benzo(b)fluoranthene	TXO	1,4-Dichlorobenzene	TXO
Benzo(ghi)perylene	TXO	2-Chloronaphthalene	TXO
Benzo(k)fluoranthene	TXO	2,4-Dinitrotoluene	TXO
Bis(2-chloroisopropyl)ether	TXO	3,3'-Dichlorobenzidine	TXO
Bromomethane	TXO	4-Bromophenyl Phenyl Ether	TXO
Chloroethane	TXO	4-Chlorophenylphenyl Ether	TXO
Chloromethane	TXO	Aniline, 2,4,5-Trimethyl	NCO
Chrysene	TXO	Aramite	NCO
Di-n-propylnitrosamine	TXO	Benzanthrone	NCO
Dibenzo(a,h)anthracene	TXO	Benzenethiol	NCO
Fluoranthene	TXO	Benzonitrile, 3,5-dibromo-4-hydroxy-	NCO
Fluorene	TXO	Beta-Naphthylamine	NCO
Hexachlorobenzene	TXO	Biphenyl, 4-Nitro	NCO
Hexachlorobutadiene	TXO	Carbazole	NCO
Hexachlorocyclopentadiene	TXO	Carbon Disulfide	NCO
Hexachloroethane	TXO	Chloroacetonitrile	NCO
Indeno(1,2,3-cd)pyrene	TXO	cis-1,3-Dichloropropene	NCO
N-Nitrosodimethylamine	TXO	Crotonaldehyde	NCO
Nitrobenzene	TXO	Crotoxyphos	NCO
Pyrene	TXO	Dibenzothiophene	NCO
Tribromomethane	TXO	Dibromomethane	NCO
Diethyl Ether	NCO	Phenacetin	NCO
Diphenyldisulfide	NCO	Phenothiazine	NCO

Table 5-6 (Continued)

Pollutant	Class Code	Pollutant	Class Code
Ethane, Pentachloro-	NCO	Pronamide	NCO
Ethyl Cyanide	NCO	Pyridine	NCO
Ethyl Methacrylate	NCO	Resorcinol	NCO
Ethyl Methanesulfonate	NCO	Squalene	NCO
Ethylenethiourea	NCO	Thianaphthene	NCO
Hexachloropropene	NCO	Thioacetamide	NCO
Iodomethane	NCO	Thioxanthe-9-one	NCO
Isosafrole	NCO	Toluene, 2,4-diamino	NCO
Longifolene	NCO	Trans-1,4-dichloro-2-butene	NCO
Malachite Green	NCO	Triphenylene	NCO
Mestranol	NCO	Vinyl Acetate	NCO
Methapyrilene	NCO	1-Bromo-2-chlorobenzene	NCO
Methyl Methanesulfonate	NCO	1-Bromo-3-chlorobenzene	NCO
N-Nitrosodi-N-butylamine	NCO	1-Chloro-3-nitrobenzene	NCO
N-Nitrosodiethylamine	NCO	1-Naphthylamine	NCO
N-Nitrosomethylethylamine	NCO	1-Phenylnaphthalene	NCO
N-Nitrosomethylphenylamine	NCO	1,1,1,2-Tetrachloroethane	NCO
N-Nitrosopiperidine	NCO	1,2-Dibromo-3-chloropropane	NCO
N,N-Dimethylformamide	NCO	1,2-Dibromoethane	NCO
o-Anisidine	NCO	1,2,3-Trichlorobenzene	NCO
o-Toluidine	NCO	1,2,3-Trichloropropane	NCO
o-Toluidine, 5-Chloro-	NCO	1,2,3-Trimethoxybenzene	NCO
p-Chloroaniline	NCO	1,2,4,5-Tetrachlorobenzene	NCO
p-Dimethylaminoazobenzene	NCO	1,2,3,4-Diepoxybutane	NCO
p-Nitroaniline	NCO	1,3-Butadiene, 2-Chloro	NCO
Pentachlorobenzene	NCO	1,3-Dichloro-2-propanol	NCO
Perylene	NCO	1,3-Dichloropropane	NCO
1,3,5-Trithiane	NCO	Bismuth	NCM
1,4-Dinitrobenzene	NCO	Cerium	NCM
1,4-Naphthoquinone	NCO	Dysprosium	NCM
1,5-Naphthalenediamine	NCO	Erbium	NCM
2-(Methylthio)benzothiazole	NCO	Europium	NCM

Table 5-6 (Continued)

Pollutant	Class Code	Pollutant	Class Code
2-Isopropylnaphthalene	NCO	Gadolinium	NCM
2-Methylbenzothioazole	NCO	Gallium	NCM
2-Nitroaniline	NCO	Germanium	NCM
2-Phenylnaphthalene	NCO	Gold	NCM
2-Picoline	NCO	Hafnium	NCM
2-Propen-1-ol	NCO	Holmium	NCM
2-Propenenitrile, 2-Methyl-	NCO	Indium	NCM
2,3-Benzofluorene	NCO	Lanthanum	NCM
2,3-Dichloronitrobenzene	NCO	Lutetium	NCM
2,3,4,6-Tetrachlorophenol	NCO	Neodymium	NCM
2,6-Di-tert-butyl-p-benzoquinone	NCO	Niobium	NCM
2,6-Dichloro-4-nitroaniline	NCO	Osmium	NCM
2,6-Dichlorophenol	NCO	Palladium	NCM
3-Chloropropene	NCO	Platinum	NCM
3-Methylcholanthrene	NCO	Praseodymium	NCM
3-Nitroaniline	NCO	Rhenium	NCM
3,3'-Dimethoxybenzidine	NCO	Rhodium	NCM
3,6-Dimethylphenanthrene	NCO	Ruthenium	NCM
4-Aminobiphenyl	NCO	Samarium	NCM
4-Chloro-2-nitroaniline	NCO	Scandium	NCM
4,4'-Methylenebis(2-chloroaniline)	NCO	Tantalum	NCM
4,5-Methylene Phenanthrene	NCO	Tellurium	NCM
5-Nitro-o-toluidine	NCO	Terbium	NCM
7,12-Dimethylbenz(a)anthracene	NCO	Thorium	NCM
Thulium	NCM	Ytterbium	NCM
Tungsten	NCM	Zirconium	NCM
Uranium	NCM		

NCM - Nonconventional metal or element.
NCO - Nonconventional organic.
TXO - Toxic organic.

Table 5-7

Pollutants Detected in Less Than 10 Percent of Samples Analyzed During the 1993-1996 Industrial Laundries Sampling Program

Priority Organics	Nonconventional Organics
Acrylonitrile	Acetophenone
Benzene	Aniline
Bis(2-chloroethoxy)methane	Biphenyl
Bis (2-chloroethyl)ether	Dibenzofuran
Bromodichloromethane	2,3-Dichloroaniline
2-Chloroethylvinyl ether	Dimethyl sulfone
2-Chlorophenol	1,4-Dioxane
Dibromochloromethane	Diphenylamine
1.1-Dichloroethane	Diphenyl ether
1,2-Dichloroethane	2-Hexanone
1,1-Dichloroethene	Isobutyl alcohol
2,4-Dichlorophenol	1-Methylfluorene
Diethyl phthalate	1-Methylphenanthrene
2,4-Dimethylphenol	Methyl methacrylate
Dimethyl phthalate	N-Nitrosomorpholine
2,4-Dinitrophenol	o-Cresol
2,6-Dinitrotoluene	Safrole
2-Nitrophenol	Styrene
4-Nitrophenol	Trichlorofluoromethane
N-Nitrosodiphenylamine	2,3,6-Trichlorophenol
Pentachlorophenol	2,4,5-Trichlorophenol
Phenanthrene	Tripropyleneglycol methyl ether
Phenol,2-Methyl-4,6-Dinitro-	
2-Propenal	
1,1,2,2-Tetrachloroethane	
Tetrachloromethane	
Trans-1,3-Dichloropropene	
2,4,6-Trichlorophenol	

Table 5-8

Semiquantitative Metal and Elemental Pollutants Excluded from the Pollutants of Concern for the Industrial Laundries Industry

Nonconventional Metals and Elements
Iodine
Iridium
Lithium
Phosphorus
Potassium
Silicon
Strontium
Sulfur

- Pollutants likely to be regulated on a case-by-case basis by POTWs. The following six pollutants were eliminated from the pollutant-of-concern list:

  – pH: this pollutant is typically regulated as necessary by POTWs. pH is not considered for national regulation for the industrial laundries industry.

  – Total orthophosphate, total phosphorous, and total hydrolyzable phosphate: Table 5-9 presents the average influent concentrations, effluent concentrations, and percent removals for these pollutants by both the dissolved air flotation (DAF) and chemical precipitation treatment technologies (based on six sampling episodes between 1993-1998). These pollutants were not considered for national regulation for the industrial laundries industry since they would be removed incidentally by the DAF and chemical precipitation treatment technologies.

  – Surfactants (nonionic (CTAS) and anionic (MBAS)): Table 5-9 presents the average influent concentrations, effluent concentrations, and percent removals for these pollutants by both the dissolved air flotation and chemical precipitation treatment technologies (based on six sampling episodes between 1993-1998). These pollutants were analyzed to evaluate the effect of emulsions on treatment technologies for the industrial laundries industry. Surfactants are not considered for national regulation for the industrial laundries industry since they would be removed incidentally by the DAF and chemical precipitation treatment technologies.

In addition to the pollutants above, EPA eliminated total solids from further consideration. Total solids is a measure of total dissolved solids and total suspended solids. Industrial laundry wastewater contains both total suspended solids and total solids. Because the measurement of total solids includes total suspended solids and because the treatment technologies under consideration as the bases of the regulation are designed to remove the total suspended solids but not the dissolved solids, EPA eliminated total solids from further consideration.

Of the 315 pollutants considered for regulation, 72 were identified as pollutant parameters of concern, including 31 priority pollutants (18 organic pollutants and 13 metal and elemental pollutants), three conventional pollutants, and 38 nonconventional pollutants (24 organic pollutants, 11 metal and elemental pollutants, and three other nonconventional pollutants). Table 5-10 presents these 72 pollutants, along with the number of times each pollutant was analyzed and detected in untreated industrial laundry wastewater, and the corresponding mean, minimum, and maximum concentrations based on data collected between 1993 and 1996 (seven facilities).

Table 5-9

Average Influent Concentrations, Effluent Concentrations, and Removals for Phosphorous and Surfactants by Chemical Precipitation or Dissolved Air Flotation Technologies

Pollutant	Average Influent (mg/L)	Average Effluent (mg/L)	Average Percent Removal
Chemical Precipitation			
Total Hydrolyzable Phosphorous	75.6	9.43	88
Total Orthophosphate	2.80	1.70	39
Total Phosphorous	30.8	6.83	78
Surfactants (anionic)	12.0	6.23	48
Surfactants (nonionic)	149	116	22
Dissolved Air Flotation			
Total Hydrolyzable Phosphorous	10.8	5.15	52
Total Orthophosphate	6.88	2.95	57
Total Phosphorous	21.4	8.94	58
Surfactants (anionic)	7.64	0.818	89
Surfactants (nonionic)	446	202	55

Table 5-10

Pollutants of Concern for the Industrial Laundries Industry[1]

Pollutant of Concern	Number of Times Analyzed	Number of Times Detected	Percent Detected (%)	Concentration in Untreated Wastewater (mg/L)		
				Minimum	Maximum	Mean
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	46	46	100.00	218.00	9810.00	2343.50
Oil and Grease (measured as HEM)	48	48	100.00	71.50	11790.00	1943.92
Total Suspended Solids (TSS)	46	45	97.83	4.00	7000.00	1773.93
Priority Organics						
1,1,1-Trichloroethane	48	22	45.83	0.01	156.64	4.01
1,2-Diphenylhydrazine	47	5	10.64	0.02	41.32	1.14
4-Chloro-3-methylphenol	47	8	17.02	0.01	2.06	0.14
Bis(2-ethylhexyl) Phthalate	47	43	91.49	0.04	42.01	6.80
Butyl Benzyl Phthalate	47	20	42.55	0.01	74.42	2.69
Chlorobenzene	48	8	16.67	0.01	1.41	0.08
Chloroform	48	25	52.08	0.01	1.19	0.07
Di-*n*-butyl Phthalate	47	20	42.55	0.01	9.98	0.73
Di-*n*-octyl Phthalate	47	25	53.19	0.01	2.61	0.30
Ethylbenzene	48	38	79.17	0.01	18.74	1.24
Isophorone	47	5	10.64	0.01	1.00	0.12
Methylene Chloride	48	25	52.08	0.01	16.26	0.63
Naphthalene	47	42	89.36	0.01	18.75	2.59
Phenol	47	23	48.94	0.01	0.96	0.15
Tetrachloroethene	48	35	72.92	0.01	46.22	1.97
Toluene	48	44	91.67	0.01	90.97	6.72
trans-1,2-Dichloroethene	48	1	2.08	0.01	0.10	0.03
Trichloroethene	48	7	14.58	0.01	20.00	0.48

Table 5-10 (Continued)

Pollutant of Concern	Number of Times Analyzed	Number of Times Detected	Percent Detected (%)	Concentration in Untreated Wastewater (mg/L)		
				Minimum	Maximum	Mean
Nonconventional Organics						
2-Butanone	48	32	66.67	0.05	272.29	9.07
2-Methylnaphthalene	47	32	68.09	0.01	2.24	0.41
2-Propanone	48	46	95.83	0.05	603.15	20.95
4-Methyl-2-pentanone	48	26	54.17	0.05	65.27	2.65
∝-Terpineol	47	17	36.17	0.01	5.20	0.33
Benzoic Acid	47	34	72.34	0.05	12.23	1.77
Benzyl Alcohol	47	21	44.68	0.01	12.52	0.81
Hexanoic Acid	47	14	29.79	0.01	1.81	0.12
m-Xylene	48	40	83.33	0.01	25.29	2.29
n-Decane	47	41	87.23	0.01	712.40	51.60
n-Docosane	47	31	65.96	0.01	3.04	0.35
n-Dodecane	47	40	85.11	0.01	105.57	14.37
n-Eicosane	47	43	91.49	0.01	84.57	4.06
n-Hexacosane	47	27	57.45	0.01	3.73	0.36
n-Hexadecane	47	43	91.49	0.01	91.57	6.70
n-Octacosane	47	21	44.68	0.01	1.44	0.19
n-Octadecane	47	42	89.36	0.01	19.36	1.92
n-Tetracosane	47	25	53.19	0.01	8.34	0.46
n-Tetradecane	47	37	78.72	0.01	41.58	4.39
n-Triacontane	47	29	61.70	0.01	1.00	0.19
o-&*p*-Xylene	48	40	83.33	0.01	17.80	1.59
p-Cresol	47	1	2.13	0.01	0.20	0.06
p-Cymene	47	16	34.04	0.01	19.81	1.43
Pentamethylbenzene	47	11	23.40	0.01	2.33	0.22

Table 5-10 (Continued)

Pollutant of Concern	Number of Times Analyzed	Number of Times Detected	Percent Detected (%)	Concentration in Untreated Wastewater (mg/L)		
				Minimum	Maximum	Mean
Priority Metals and Elements						
Antimony	47	34	72.34	0.01	8.24	0.26
Arsenic	47	15	31.91	0.010	0.18	0.02
Beryllium	47	18	38.30	0.010	0.02	0.003
Cadmium	47	44	93.62	0.010	0.70	0.10
Chromium	47	45	95.74	0.010	7.31	0.46
Copper	47	47	100.00	0.04	14.90	3.17
Lead	47	45	95.74	0.03	23.80	1.71
Mercury	47	28	59.57	0.010	0.01	0.001
Nickel	47	45	95.74	0.01	2.87	0.27
Selenium	47	12	25.53	0.010	0.26	0.03
Silver	47	24	51.06	0.010	0.17	0.02
Thallium	47	6	12.77	0.010	0.13	0.01
Zinc	47	46	97.87	0.010	29.40	5.02
Nonconventional Metals and Elements						
Aluminum	47	47	100.00	0.03	20.99	7.96
Barium	47	47	100.00	0.03	6.26	1.51
Boron	47	36	76.60	0.03	37.20	2.31
Cobalt	47	37	78.72	0.000	3.10	0.24
Iron	47	47	100.00	0.06	96.60	27.70
Manganese	47	47	100.00	0.02	1.77	0.56
Molybdenum	47	43	91.49	0.010	5.17	0.53
Tin	47	32	68.09	0.02	0.58	0.11
Titanium	47	45	95.74	0.01	1.32	0.23
Vanadium	47	31	65.96	0.010	0.19	0.04
Yttrium	47	15	31.91	0.010	0.04	0.01

Table 5-10 (Continued)

Pollutant of Concern	Number of Times Analyzed	Number of Times Detected	Percent Detected (%)	Concentration in Untreated Wastewater (mg/L)		
				Minimum	Maximum	Mean
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	47	47	100.00	80.00	212000.00	12730.57
Total Organic Carbon (TOC)	47	47	100.00	106.00	37800.00	2208.32
Total Petroleum Hydrocarbon (measured as SGT-HEM)	43	43	100.00	7.00	4543.00	880.86

[1]Results are based on sampling data collected between 1993 and 1996 from seven industrial laundries facilities.

5.7 Characterization of Raw Wastewater by Item Laundered

As discussed in Chapter 4 of this document, items laundered at industrial laundries can have significantly different pollutant loads based on item type and customer. This section presents raw wastewater characterization data for specific items laundered for the 72 pollutants of concern detected in industrial laundry wastewater. Table 5-11 presents for the 72 pollutants the mean pollutant concentration by item type. Table C-3 in Appendix C of this document presents for the 72 pollutants the minimum, maximum, and mean concentrations, as well as the number of times each pollutant was analyzed, the number of times the pollutant was detected, and the percentage of times the pollutant was detected, by item type based on sampling data from nine facilities and DMQ data.

5.8 Characterization of Total, Heavy, and Light Raw Wastewater Streams

This section presents raw wastewater characterization data for total, heavy, and light raw wastewater streams at industrial laundries. The heavy and light wastewater streams were designated as such by the sampled facilities; generally, the heavy wastewater stream is generated from laundering items with high pollutant loadings and the light wastewater stream is generated from laundering items with low pollutant loadings. At some facilities, the heavy stream is generated from wastewater from the first several breaks of laundering a variety of items. The heavy stream is typically treated and combined with the untreated light stream prior to discharge to a POTW.

EPA sampling program data and detailed monitoring questionnaire (DMQ) data from facilities that do not split their heavy and light wastewater streams were used to characterize total raw wastewater streams. The total stream is then discharged, with or without treatment, to a POTW. EPA sampling program data from facilities that split their wastewater streams were used to characterize heavy and light wastewater streams.

Tables 5-12 through 5-14 present for 72 pollutants of concern the mean concentrations for heavy, light, and total raw wastewater streams based on data collected through EPA's sampling program (nine facilities) and data from the detailed monitoring questionnaire. Table C-4 in Appendix C of this document presents for the 72 pollutants of concern the minimum, maximum, and mean concentrations, as well as the number of times the pollutant was analyzed, the number of times the pollutant was detected, and the percentage of times the pollutant was detected. In general, the concentrations of pollutants in heavy wastewater streams are greater than the concentrations of pollutants in total wastewater streams, and the concentrations of pollutants in total wastewater streams are greater than the concentrations of pollutants in light wastewater streams.

5.9 Characterization of Method 1664 Constituents

In response to comments on the proposed rule, EPA conducted a characterization study on wastewater generated at industrial laundries to determine the specific constituents of oil and grease and TPH, measured using EPA Method 1664. EPA collected influent and effluent

Table 5-11

Wastewater Characterization for Item-Specific Wastewater at Industrial Laundries

Pollutant of Concern	Mean Concentration (mg/L)[1]			
	Industrial Garments	Shop Towels	Printer Towels	Mats
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	350	2,780	3,940	179
Oil and Grease (measured as HEM)	149	3,250	5,890	105
Total Suspended Solids (TSS)	304	4,450	1,250	690
Priority Organics				
1,1,1-Trichloroethane	0.0400	4.13	4.50	0.860
1,2-Diphenylhydrazine	0.110	1.07	1.00	0.0200
4-Chloro-3-methylphenol	0.130	0.795	0.433	0.0100
Bis(2-ethylhexyl) Phthalate	0.838	3.63	19.0	1.70
Butyl Benzyl Phthalate	0.111	1.46	5.55	0.0350
Chlorobenzene	0.0400	0.252	0.467	0.0100
Chloroform	0.0400	0.292	0.370	0.0100
Di-*n*-butyl Phthalate	0.0736	0.558	3.20	0.114
Di-*n*-octyl Phthalate	0.0583	0.538	1.24	0.0369
Ethylbenzene	0.104	5.27	13.2	0.147
Isophorone	0.194	9.58	0.500	0.186
Methylene Chloride	0.0406	4.22	0.614	0.226
Naphthalene	0.107	2.91	9.64	0.0172
Phenol	0.0544	0.310	0.500	0.0134
Tetrachloroethene	0.0400	8.92	3.92	0.0676
Toluene	0.0486	5.33	20.5	0.654
trans-1,2-Dichloroethene	0.0400	0.367	0.371	0.0100
Trichloroethene	0.0400	0.247	0.476	0.0100
Nonconventional Organics				
2-Butanone	0.200	5.40	3.09	0.314
2-Methylnaphthalene	0.102	0.826	0.836	0.0100
2-Propanone	0.226	3.98	49.7	1.10
4-Methyl-2-pentanone	0.200	1.88	2.07	0.254
∝-Terpineol	0.0550	0.956	1.07	0.0463
Benzoic Acid	0.353	2.55	3.30	0.156
Benzyl Alcohol	0.132	9.26	0.500	0.0520
Hexanoic Acid	0.0962	0.305	0.433	0.0611
m-Xylene	0.0100	2.12	1.44	0.265
n-Decane	0.807	42.2	90.6	0.995
n-Docosane	0.271	1.10	0.668	0.0175
n-Dodecane	1.26	19.1	23.1	0.0654
n-Eicosane	0.471	25.1	1.29	0.0206
n-Hexacosane	0.117	1.40	2.01	0.0211
n-Hexadecane	0.602	10.0	9.51	0.0206
n-Octacosane	0.0821	0.858	0.402	0.0134

Table 5-11 (Continued)

Pollutant of Concern	Mean Concentration (mg/L)[1]			
	Industrial Garments	Shop Towels	Printer Towels	Mats
Nonconventional Organics (Continued)				
n-Octadecane	0.445	11.2	2.43	0.0160
n-Tetracosane	0.281	1.95	0.605	0.0394
n-Tetradecane	0.612	15.0	7.89	0.0145
n-Triacontane	0.123	0.719	0.626	0.0292
o-&*p*-Xylene	0.0100	1.47	1.08	0.151
p-Cresol	0.0417	0.305	0.433	0.0100
p-Cymene	0.0873	2.05	12.4	0.0100
Pentamethylbenzene	0.0550	0.534	0.500	0.0100
Priority Metals and Elements				
Antimony	0.312	0.198	0.0556	0.0204
Arsenic	0.00907	0.0224	0.00313	0.00905
Beryllium	0.000605	0.000890	0.00100	0.000775
Cadmium	0.0269	0.358	0.0253	0.0147
Chromium	0.0959	0.490	2.65	0.167
Copper	0.688	6.48	11.0	1.31
Lead	0.238	6.52	8.91	0.711
Mercury	0.000395	0.00183	0.000230	0.00142
Nickel	0.0999	0.599	0.101	0.152
Selenium	0.00767	0.0145	0.0177	0.00305
Silver	0.0146	0.139	0.207	0.0168
Thallium	0.00293	0.00390	0.00767	0.00680
Zinc	1.50	13.5	3.62	2.42
Nonconventional Metals and Elements				
Aluminum	4.85	13.1	8.22	10.3
Barium	0.273	4.08	4.53	0.376
Boron	0.187	1.99	0.670	0.0818
Cobalt	0.0134	0.288	0.614	0.0184
Iron	10.9	55.8	8.51	24.7
Manganese	0.148	1.09	0.898	0.318
Molybdenum	0.0213	0.382	2.10	0.0321
Tin	0.0722	0.370	0.0990	0.0938
Titanium	0.150	0.232	0.184	0.364
Vanadium	0.00707	0.0420	0.00900	0.0273
Yttrium	0.00178	0.00794	0.00570	0.00675
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	1,170	13,300	16,900	515
Total Organic Carbon (TOC)	367	2,030	2,740	111
Total Petroleum Hydrocarbon (measured as SGT-HEM)	47.4	1,760	1,730	48.5

Table 5-11 (Continued)

Constituent Name	Mean Concentration (mg/L)[1]			
	Mops	Steam-Tumbled Printer Towels	Items Dry Cleaned Prior to Water Washing	Linen Supply Items
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	1,150	1,440	113	881
Oil and Grease (measured as HEM)	286	1,720	NA	108
Total Suspended Solids (TSS)	1,100	1,320	82	269
Priority Organics				
1,1,1-Trichloroethane	1.04	0.0118	NA	0.00833
1,2-Diphenylhydrazine	0.200	0.0800	NA	0.0200
4-Chloro-3-methylphenol	0.100	0.0400	NA	0.0100
Bis(2-ethylhexyl) Phthalate	1.10	8.77	NA	0.574
Butyl Benzyl Phthalate	0.895	0.366	NA	0.0944
Chlorobenzene	0.0550	0.0100	NA	0.00833
Chloroform	0.0565	0.0100	NA	0.889
Di-*n*-butyl Phthalate	0.434	0.117	NA	0.0306
Di-*n*-octyl Phthalate	0.108	0.325	NA	0.0572
Ethylbenzene	0.0550	0.0100	0.0458	0.00833
Isophorone	0.100	0.0400	NA	0.0100
Methylene Chloride	0.0767	0.0100	NA	0.0112
Naphthalene	0.471	0.226	NA	0.108
Phenol	0.100	0.0432	NA	0.0674
Tetrachloroethene	0.0550	0.0100	NA	0.00833
Toluene	0.0597	0.0436	0.225	0.0241
trans-1,2-Dichloroethene	0.0550	0.0100	NA	0.00833
Trichloroethene	0.0550	0.0100	NA	0.00833
Nonconventional Organics				
2-Butanone	1.13	0.0500	NA	0.0500
2-Methylnaphthalene	0.432	0.0400	NA	0.0164
2-Propanone	2.22	0.681	NA	0.0607
4-Methyl-2-pentanone	0.275	0.0500	NA	0.0500
∝-Terpineol	0.100	0.0400	NA	0.0339
Benzoic Acid	2.35	0.977	NA	0.150
Benzyl Alcohol	0.610	0.819	NA	0.202
Hexanoic Acid	0.216	0.384	NA	0.0279
m-Xylene	0.100	0.0151	NA	0.0100
n-Decane	0.965	0.499	NA	2.63
n-Docosane	0.157	0.131	NA	0.0392
n-Dodecane	8.07	2.65	NA	0.270
n-Eicosane	0.291	3.05	NA	0.0862
n-Hexacosane	0.210	0.0904	NA	0.0267
n-Hexadecane	1.07	91.6	NA	0.160

Table 5-11 (Continued)

Constituent Name	Mean Concentration (mg/L)[1]			
	Mops	Steam-Tumbled Printer Towels	Items Dry Cleaned Prior to Water Washing	Linen Supply Items
Nonconventional Organics (Continued)				
n-Octacosane	0.221	0.0633	NA	0.0212
n-Octadecane	0.875	1.48	NA	0.0720
n-Tetracosane	0.100	0.0724	NA	0.0630
n-Tetradecane	1.47	12.8	NA	0.140
n-Triacontane	0.163	0.0587	NA	0.0551
o-&*p*-Xylene	0.100	0.0146	NA	0.0100
p-Cresol	0.100	0.0400	NA	0.0100
p-Cymene	0.100	0.0400	NA	0.108
Pentamethylbenzene	0.100	0.0400	NA	0.0100
Priority Metals and Elements				
Antimony	0.0294	0.0261	NA	0.114
Arsenic	0.0102	0.00380	0.00500	0.156
Beryllium	0.00100	0.00100	NA	0.00100
Cadmium	0.0212	0.0358	0.0825	0.0219
Chromium	0.101	0.275	0.0933	0.0492
Copper	1.97	4.86	0.668	0.527
Lead	0.903	0.957	0.519	0.151
Mercury	0.00466	0.000200	0.000150	0.00165
Nickel	0.106	0.0372	0.0200	0.0771
Selenium	0.0123	0.0230	NA	0.151
Silver	0.0111	0.0653	0.00500	0.0291
Thallium	0.00620	0.0120	NA	0.00700
Zinc	3.00	2.10	0.450	0.381
Nonconventional Metals and Elements				
Aluminum	9.78	2.80	NA	3.08
Barium	0.571	1.63	NA	0.301
Boron	0.190	0.0500	NA	0.0970
Cobalt	0.0360	0.202	NA	0.00990
Iron	17.9	2.62	NA	3.26
Manganese	0.358	0.277	NA	0.0812
Molybdenum	0.0612	2.64	NA	0.0263
Tin	0.0785	0.0761	NA	0.0290
Titanium	0.184	0.0178	NA	0.0654
Vanadium	0.0220	0.0221	NA	0.00990
Yttrium	0.004500	0.00500	NA	0.00470

Table 5-11 (Continued)

Constituent Name	Mean Concentration (mg/L)[1]			
	Mops	Steam-Tumbled Printer Towels	Items Dry Cleaned Prior to Water Washing	Linen Supply Items
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	5,410	9,000	638	844
Total Organic Carbon (TOC)	518	1,770	NA	401
Total Petroleum Hydrocarbon (measured as SGT-HEM)	111	468	NA	12

[1]The detection limit concentration was used in calculations for data points reported as nondetects.
NA - Not available. No data were available for this constituent.

Table 5-12

Wastewater Characterization Data for Heavy Wastewater Streams at Industrial Laundries

Pollutant of Concern	Mean Concentration[1] (mg/L)
Conventionals	
Biochemical Oxygen Demand 5-Day (BOD_5)	4,160
Oil and Grease (measured as HEM)	2,950
Total Suspended Solids (TSS)	2,320
Priority Organics	
1,1,1-Trichloroethane	1.16
1,2-Diphenylhydrazine	2.60
4-Chloro-3-methylphenol	0.260
Bis(2-ethylhexyl) Phthalate	11.3
Butyl Benzyl Phthalate	8.89
Chlorobenzene	0.271
Chloroform	0.296
Di-*n*-butyl Phthalate	1.30
Di-*n*-octyl Phthalate	0.599
Ethylbenzene	3.65
Isophorone	0.207
Methylene Chloride	0.854
Naphthalene	4.76
Phenol	0.303
Tetrachloroethene	1.79
Toluene	9.69
trans-1,2-Dichloroethene	0.271
Trichloroethene	1.27
Nonconventional Organics	
2-Butanone	25.5
2-Methylnaphthalene	0.892
2-Propanone	8.49
4-Methyl-2-pentanone	5.82
∝-Terpineol	0.379

Table 5-12 (Continued)

Pollutant of Concern	Mean Concentration[1] (mg/L)
Nonconventional Organics (Continued)	
Benzoic Acid	3.36
Benzyl Alcohol	1.56
Hexanoic Acid	0.210
m-Xylene	4.47
n-Decane	86.5
n-Docosane	0.504
n-Dodecane	29.5
n-Eicosane	4.28
n-Hexacosane	0.354
n-Hexadecane	9.11
n-Octacosane	0.370
n-Octadecane	4.00
n-Tetracosane	0.289
n-Tetradecane	7.23
n-Triacontane	0.366
o-&*p*-Xylene	3.59
p-Cresol	0.204
p-Cymene	3.16
Pentamethylbenzene	0.412
Priority Metals and Elements	
Antimony	0.788
Arsenic	0.0125
Beryllium	0.00142
Cadmium	0.121
Chromium	0.296
Copper	5.37
Lead	1.60
Mercury	0.000816
Nickel	0.266
Selenium	0.0174
Silver	0.199

Table 5-12 (Continued)

Pollutant of Concern	Mean Concentration[1] (mg/L)
Priority Metals and Elements (Continued)	
Thallium	0.00989
Zinc	7.79
Nonconventional Metals and Elements	
Aluminum	9.97
Barium	3.63
Boron	4.93
Cobalt	0.449
Iron	42.1
Manganese	1.51
Molybdenum	0.668
Tin	0.130
Titanium	0.344
Vanadium	0.0381
Yttrium	0.0101
Bulk Nonconventionals	
Chemical Oxygen Demand (COD)	13,700
Total Organic Carbon (TOC)	2,790
Total Petroleum Hydrocarbon (measured as SGT-HEM)	1,440

[1]The detection limit concentration was used in calculations for data points reported as nondetects.

Table 5-13

Wastewater Characterization Data for Light Wastewater Streams at Industrial Laundries

Pollutant of Concern	Mean Concentration[1] (mg/L)
Conventionals	
Biochemical Oxygen Demand 5-Day (BOD_5)	568
Oil and Grease (measured as HEM)	154
Total Suspended Solids (TSS)	344
Priority Organics	
1,1,1-Trichloroethane	0.0160
1,2-Diphenylhydrazine	0.220
4-Chloro-3-methylphenol	0.0411
Bis(2-ethylhexyl) Phthalate	1.10
Butyl Benzyl Phthalate	0.0690
Chlorobenzene	0.0160
Chloroform	0.0455
Di-*n*-butyl Phthalate	0.104
Di-*n*-octyl Phthalate	0.0667
Ethylbenzene	0.0620
Isophorone	0.0400
Methylene Chloride	0.0213
Naphthalene	0.358
Phenol	0.105
Tetrachloroethene	0.0977
Toluene	0.0553
trans-1,2-Dichloroethene	0.0160
Trichloroethene	0.0160
Nonconventional Organics	
2-Butanone	0.147
2-Methylnaphthalene	0.0566
2-Propanone	0.518
4-Methyl-2-pentanone	0.240
∝-Terpineol	0.123

Table 5-13 (Continued)

Pollutant of Concern	Mean Concentration[1] (mg/L)
Nonconventional Organics (Continued)	
Benzoic Acid	0.306
Benzyl Alcohol	0.102
Hexanoic Acid	0.0557
m-Xylene	0.0555
n-Decane	0.354
n-Docosane	0.0591
n-Dodecane	0.973
n-Eicosane	0.124
n-Hexacosane	0.0465
n-Hexadecane	0.330
n-Octacosane	0.0432
n-Octadecane	0.0850
n-Tetracosane	0.0680
n-Tetradecane	0.103
n-Triacontane	0.0492
o-&*p*-Xylene	0.0765
p-Cresol	0.0400
p-Cymene	0.0473
Pentamethylbenzene	0.0787
Priority Metals and Elements	
Antimony	1.32
Arsenic	0.00653
Beryllium	0.000938
Cadmium	0.0211
Chromium	0.113
Copper	0.858
Lead	0.348
Mercury	0.000715
Nickel	0.101
Selenium	0.0133
Silver	0.00432

Table 5-13 (Continued)

Pollutant of Concern	Mean Concentration[1] (mg/L)
Priority Metals and Elements (Continued)	
Thallium	0.00313
Zinc	1.47
Nonconventional Metals and Elements	
Aluminum	4.65
Barium	0.421
Boron	0.391
Cobalt	0.0264
Iron	10.3
Manganese	0.184
Molybdenum	0.0357
Tin	0.0625
Titanium	0.206
Vanadium	0.0138
Yttrium	0.00313
Bulk Nonconventionals	
Chemical Oxygen Demand (COD)	1,410
Total Organic Carbon (TOC)	338
Total Petroleum Hydrocarbon (measured as SGT-HEM)	85

[1]The detection limit concentration was used in calculations for data points reported as nondetects.

Table 5-14

Wastewater Characterization Data for Total Raw Wastewater Streams at Industrial Laundries

Pollutant	Mean Concentration[1] (mg/L)
Conventionals	
Biochemical Oxygen Demand 5-Day (BOD_5)	933
Oil and Grease (measured as HEM)	1,670
Total Suspended Solids (TSS)	1,200
Priority Organics	
1,1,1-Trichloroethane	0.283
1,2-Diphenylhydrazine	0.0918
4-Chloro-3-methylphenol	0.0684
Bis(2-ethylhexyl) Phthalate	4.99
Butyl Benzyl Phthalate	0.140
Chlorobenzene	0.131
Chloroform	0.0359
Di-*n*-butyl Phthalate	0.245
Di-*n*-octyl Phthalate	0.0910
Ethylbenzene	0.634
Isophorone	0.154
Methylene Chloride	0.366
Naphthalene	1.47
Phenol	0.0777
Tetrachloroethene	3.91
Toluene	2.64
trans-1,2-Dichloroethene	0.0204
Trichloroethene	0.0346
Nonconventional Organics	
2-Butanone	2.51
2-Methylnaphthalene	0.166
2-Propanone	10.9
4-Methyl-2-pentanone	1.67
∝-Terpineol	0.258

Table 5-14 (Continued)

Pollutant	Mean Concentration[1] (mg/L)
Nonconventional Organics (continued)	
Benzoic Acid	0.648
Benzyl Alcohol	0.143
Hexanoic Acid	0.125
m-Xylene	4.35
n-Decane	73.6
n-Docosane	0.659
n-Dodecane	6.16
n-Eicosane	1.97
n-Hexacosane	0.413
n-Hexadecane	4.76
n-Octacosane	0.0853
n-Octadecane	1.78
n-Tetracosane	1.51
n-Tetradecane	4.44
n-Triacontane	0.144
o-&*p*-Xylene	2.48
p-Cresol	0.0585
p-Cymene	0.138
Pentamethylbenzene	0.242
Priority Metals and Elements	
Antimony	0.0913
Arsenic	0.0183
Beryllium	0.00598
Cadmium	0.0641
Chromium	0.315
Copper	1.74
Lead	0.955
Mercury	0.00128
Nickel	0.305
Selenium	0.0550
Silver	0.0316

Table 5-14 (Continued)

Pollutant	Mean Concentration[1] (mg/L)
Priority Metals and Elements (continued)	
Thallium	0.0190
Zinc	2.85
Nonconventional Metals and Elements	
Aluminum	8.24
Barium	1.31
Boron	0.689
Cobalt	0.169
Iron	39.5
Manganese	0.627
Molybdenum	0.363
Tin	0.278
Titanium	0.251
Vanadium	0.0678
Yttrium	0.0199
Bulk Nonconventionals	
Chemical Oxygen Demand (COD)	6,090
Total Organic Carbon (TOC)	1,160
Total Petroleum Hydrocarbon (measured as SGT-HEM)	682

[1]The detection limit concentration was used in calculations for data points reported as nondetects.

samples from six facilities that operate DAF or chemical precipitation and that were previously sampled by EPA. See Chapter 3 of this document for a description of EPA's Method 1664 Characterization Study.

For the study, EPA analyzed wastewater samples for HEM, SGT-HEM, volatile organics, and semivolatile organics. EPA also analyzed extracts from the HEM and SGT-HEM procedures for volatile organics and semivolatile organics. The data from this study are in the Industrial Laundries Administrative Record.

Volatile organics were only detected in the HEM extracts at one facility; the only volatile organics detected in the HEM extracts were o-xylene and m-&p-xylene. Semivolatile organics were detected in all HEM and SGT-HEM extracts. Tables 5-15 and 5-16 show, for influent and effluent samples, respectively, the semivolatile organics detected in the extracts and the number of detects and average concentration of the detects in the wastewater, HEM extract, and SGT-HEM extract samples. Tables 5-15 and 5-16 also show the HEM and SGT-HEM concentrations. For one facility, no effluent concentrations are reported because there were zero percent recoveries in the matrix spike/matrix spike duplicate samples. The effluent results for this facility were excluded due to matrix interference.

The analytes that were detected in the influent samples for both the HEM and SGT-HEM extracts were 2-methylnaphthalene, bis(2-ethylhexyl) phthalate, *n*-decane, *n*-docosane, *n*-dodecane, *n*-eicosane, *n*-hexacosane, *n*-hexadecane, *n*-octacosone, *n*-octadecane, *n*-tetracosane, *n*-tetradecane, and naphthalene. The highest concentrations detected in the influent samples for both the HEM and SGT-HEM extracts were for bis(2-ethylhexyl) phthalate, *n*-decane, *n*-dodecane, *n*-hexadecane, *n*-octadecane, and *n*-tetradecane. Only bis(2-ethylhexyl) phthalate, *n*-eicosane, *n*-hexadecane, *n*-octadecane, and *n*-tetradecane were detected in the effluent samples for both the HEM and SGT-HEM extracts. These analytes were detected in lower concentrations in the effluent samples than in the influent samples.

Based on the characterization study, EPA was able to identify several constituents measured as part of the SGT-HEM (TPH) parameter. Most of the constituents identified in the influent samples were *n*-alkanes, as well as naphthalene, bis(2-ethylhexyl) phthalate and 2-methylnaphthalene. The identified constituents, however, represent only a small portion of the total SGT-HEM (TPH) measurement.

5.10 References

1. U.S. Environmental Protection Agency. List of Lists: A Catalog of Analytes and Methods. 121W-4005. Washington, DC, August 1991.

Table 5-15

Summary of the Semivolatile Organic Pollutants Detected in Influent Samples during the EPA Method 1664 Characterization Study

Pollutant	Total Number of Wastewater Samples	Total Number of Nondetects for Pollutant in Wastewater Samples	Average Concentration in Wastewater Sample[1] (ug/L)	Total Number of HEM Extract Samples	Total Number of Nondetects for Pollutants in HEM Extracts	Average Concentration in HEM Extracts[1] (ug/L)	Total Number of SGT-HEM Extract Samples	Total Number of Nondetects for Pollutants in SGT-HEM Extracts	Average Concentration in SGT-HEM Extracts[1] (ug/L)
HEM	6	0	1,920,000	NA	NA	NA	NA	NA	NA
SGT-HEM	6	0	391,000	NA	NA	NA	NA	NA	NA
1,2-Diphenylhydrazine	6	3	2,380	6	5	299	6	6	222
2-Methylnaphthalene	6	4	1,180	6	3	173	6	4	109
4-Chloro-3-methylphenol	6	3	420	6	6	111	6	6	111
Acetophenone	6	5	1,360	6	6	111	6	6	111
α-Terpineol	6	0	340	6	3	224	6	6	111
Aniline	6	6	1,340	6	6	111	6	6	111
Benzoic Acid	6	2	2,270	6	6	556	6	6	556
Benzyl Alcohol	6	2	1,090	6	6	111	6	6	111
Bis(2-ethylhexyl) Phthalate	6	1	4,780	6	0	1,400	6	1	321
Butyl Benzyl Phthalate	6	0	299	6	1	139	6	6	111
Di-*n*-butyl Phthalate	6	0	912	6	3	363	6	6	111
Di-*n*-octyl Phthalate	6	5	1,390	6	4	232	6	6	111
Diethyl Phthalate	6	5	1,340	6	6	111	6	6	111
Diphenylamine	6	4	1,350	6	6	111	6	6	111
Fluoranthene	6	5	1,180	6	6	111	6	6	111
Fluorene	6	5	1,180	6	6	111	6	6	111

Table 5-15 (Continued)

Pollutant	Total Number of Wastewater Samples	Total Number of Nondetects for Pollutant in Wastewater Samples	Average Concentration in Wastewater Sample[1] (ug/L)	Total Number of HEM Extract Samples	Total Number of Nondetects for Pollutants in HEM Extracts	Average Concentration in HEM Extracts[1] (ug/L)	Total Number of SGT-HEM Extract Samples	Total Number of Nondetects for Pollutants in SGT-HEM Extracts	Average Concentration in SGT-HEM Extracts[1] (ug/L)
Hexanoic Acid	6	3	539	6	6	111	6	6	111
Isophorone	6	4	1,520	6	5	117	6	6	111
n-Decane	6	0	26,800	6	0	2,330	6	3	1150
n-Docosane	6	0	1,660	6	1	240	6	0	210
n-Dodecane	6	0	20,500	6	0	1,590	6	0	1180
n-Eicosane	6	0	3,720	6	0	777	6	0	705
n-Hexacosane	6	2	1,400	6	2	206	6	3	193
n-Hexadecane	6	0	9,750	6	0	1,290	6	0	1220
n-Nitrosodiphenylamine	6	4	2,680	6	6	222	6	6	222
n-Tetradecane	6	0	6,320	6	0	1,570	6	0	1400
Naphthalene	6	0	1,240	6	2	583	6	2	217
o-Cresol	6	4	1,450	6	6	111	6	6	111
p-Cresol	6	6	507	6	6	111	6	6	111
p-Cymene	6	2	793	6	4	296	6	6	111
Phenanthrene	6	2	212	6	6	111	6	6	111
Phenol	6	0	91.8	6	6	111	6	6	111
Pyrene	6	3	1,180	6	6	111	6	6	111
Tripropyleneglycol Methyl Ether	6	1	182,000	6	6	1,100	6	6	1100

[1]The detection limit concentration was used in calculations for data points reported as nondetects.

NA - Not applicable.
HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table 5-16

Summary of the Semivolatile Organic Pollutants Detected in Effluent Samples during the EPA Method 1664 Characterization Study

Pollutant	Total Number of Wastewater Samples	Total Number of Nondetects for Pollutant in Wastewater Samples	Average Concentration in Wastewater Sample[1] (ug/L)	Total Number of HEM Extract Samples	Total Number of Nondetects for Pollutants in HEM Extracts	Average Concentration in HEM Extracts[1] (ug/L)	Total Number of SGT-HEM Extract Samples	Total Number of Nondetects for Pollutants in SGT-HEM Extracts	Average Concentration in SGT-HEM Extracts[1] (ug/L)
HEM	5	0	45,900	NA	NA	NA	NA	NA	NA
SGT-HEM	4	0	11,000	NA	NA	NA	NA	NA	NA
1,2-Diphenylhydrazine	5	3	27.5	5	5	48	5	5	48
2-Methylnaphthalene	5	5	10	5	5	24	5	5	24
4-Chloro-3-methylphenol	5	1	99.2	5	5	24	5	5	24
Acetophenone	5	5	10	5	5	24	5	5	24
α-Terpineol	5	0	274	5	1	25.4	5	5	24
Aniline	5	3	13.8	5	5	24	5	5	24
Benzoic Acid	5	0	1,130	5	5	120	5	5	120
Benzyl Alcohol	5	2	292	5	5	24	5	5	24
Bis(2-ethylhexyl) Phthalate	5	1	154	5	1	67.4	5	3	29.1
Butyl Benzyl Phthalate	5	3	10.2	5	4	26	5	5	24
Di-*n*-butyl Phthalate	5	5	10	5	5	24	5	5	24
Di-*n*-octyl Phthalate	5	4	10.2	5	5	24	5	5	24
Diethyl Phthalate	5	5	10	5	5	24	5	5	24
Diphenylamine	5	5	10	5	5	24	5	5	24
Fluoranthene	5	5	10	5	5	24	5	5	24
Fluorene	5	5	10	5	5	24	5	5	24
Hexanoic Acid	5	1	331	5	5	24	5	5	24
Isophorone	5	1	289	5	4	42	5	5	24

Table 5-16 (Continued)

Pollutant	Total Number of Wastewater Samples	Total Number of Nondetects for Pollutant in Wastewater Samples	Average Concentration in Wastewater Sample[1] (ug/L)	Total Number of HEM Extract Samples	Total Number of Nondetects for Pollutants in HEM Extracts	Average Concentration in HEM Extracts[1] (ug/L)	Total Number of SGT-HEM Extract Samples	Total Number of Nondetects for Pollutants in SGT-HEM Extracts	Average Concentration in SGT-HEM Extracts[1] (ug/L)
n-Decane	5	1	502	5	4	30.1	5	5	24
n-Docosane	5	1	38	5	5	24	5	5	24
n-Dodecane	5	1	250	5	4	38.5	5	5	24
n-Eicosane	5	1	67.2	5	4	28.3	5	4	27
n-Hexacosane	5	1	53.9	5	5	24	5	5	24
n-Hexadecane	5	1	116	5	3	47.2	5	4	36.2
n-Nitrosodiphenylamine	5	5	20	5	5	48	5	5	48
n-Octacosane	5	5	10	5	5	24	5	5	24
n-Octadecane	5	2	90.5	5	3	34.8	5	4	30.7
n-Tetracosane	5	1	37.1	5	5	24	5	5	24
n-Tetradecane	5	1	134	5	4	37.8	5	4	27.3
Naphthalene	5	0	90.3	5	4	25.1	5	5	24
o-Cresol	5	1	120	5	5	24	5	5	24
p-Cresol	5	2	24.5	5	5	24	5	5	24
p-Cymene	5	3	13.1	5	5	24	5	5	24
Phenanthrene	5	5	10	5	5	24	5	5	24
Phenol	5	0	175	5	5	24	5	5	24
Pyrene	5	5	10	5	5	24	5	5	24
Tripropyleneglycol Methyl Ether	5	1	11,800	5	5	238	5	5	238

[1]The detection limit concentration was used in calculations for data points reported as nondetects.

NA - Not applicable.
HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.